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Student-teachers' Pedagogical Reasoning in Technological Pedagogical Content Knowledge Design Tasks

a Cross- Country Multiple Case Study in Initial Teacher Education Institutions

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Abstract

Teachers' professional expertise is based on (but not limited to) a complex, multifaceted and situated professional knowledge, in this dissertation identified in the *Technological Pedagogical Content Knowledge* (TPCK) framework. Literature has widely investigated the interconnections between TPCK and tacit non-rational underpinnings – in this dissertation identified in the construct of *dispositions* – when it comes to integrating technologies into teaching practices. Furthermore, a successful technology integration, supported by strong knowledge bases and positive dispositions, implies specific decision-making processes to be enacted – in this dissertation identified in the construct of *pedagogical reasoning*. Hence, it is crucial to investigate how teachers reason professionally about integrating technologies, e.g. in a core teaching practice such as designing a learning unit.

Whereas quite broad is the literature on the efficacy of engaging student-teachers in design tasks supporting dispositions and TPCK's improvement, it is still unclear if and how these tasks can engage some sort of pedagogical reasoning. The present dissertation reports on a research carried out at pre-service level to investigate how TPCK-informed design tasks may engage student-teachers in pedagogical reasoning, considering their implicit dispositions on the matter of technology integration in education. The ultimate aim of the research is to provide empirical evidence for a better understanding and fostering of reasoned technology-integrated teaching practices, to the service of initial education programmes, scholars and practitioners.

Given the complexity of the phenomenon and the contextual influence on it (i.e. the specific pre-service academic strategies used), this research takes the form of a multiple case study engaging three Higher Education institutions across Europe, in their Initial Teacher Education (ITE) programmes (N=345). The multiple case study included the implementation of several instruments for data collection, namely (1) observation, (2) documentation, (3) focused interviews and (4) a pre-/post - questionnaire. The reader will find both case-specific and cross-case analyses of the phenomenon at study.

Overall, the emerging findings would suggest ITE's strategies fair efficacy in supporting student-teachers' knowledge bases and dispositions toward technology integration, both powerful and positive enablers for future behaviours. On the other hand, notwithstanding the case-specific strengths, findings suggest that part of the student-teachers' reasoning processes for technology integration in design tasks, may find its roots elsewhere. The conclusions of the present research would suggest the need for further investigation of the phenomenon.

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NOTE TO THE READER:

Intra-text cross references' formatting choices:

- reference to different paragraph, within same chapter: §number.number (e.g. §Chp.3.4);
- reference to different chapter, within same section: §Chp.number.number (e.g. §Chp.2.1);
- reference to different paragraph or chapter, in different section: §Section Letter – Chp.number.number (e.g. §A-Chp.1.2);
- pictures, figures, tables and boxes are numbered according to the single section as per Index of figures.

SECTION A.
THEORETICAL BACKGROUND

SECTION INTRODUCTION

This section introduces the theoretical background of the dissertation. The starting point is the identification of the professional competence for teaching: a deeply situated, dynamic and multifaceted knowledge (Koehler & Mishra, 2005a; Mishra & Koehler, 2006). Considering the suggestions from the reviewed literature as well as the rising demands from educational policies (e.g. Eurydice, 2018; Punye, 2017), a technology-wise framework for teacher knowledge will be described: the *Technological Pedagogical Content Knowledge – TPCK* (§Chp.1). Said framework will be presented in its introduction and development in academia (§Chp.1.1), with some evidence from research about its identification, support and assessment mainly within teacher education (§Chp.1.2, 1.3).

Knowledge and skills are not capable alone to explain the wide spectrum of teaching practices for technology integration, as other factors are recognized to have a great influence on them (Crompton, 2015; Knezek & Christensen, 2018; Niederhauser & Lindstrom, 2018; Tondeur et al., 2016a). The concept of *dispositions* will then be presented, to help understanding teachers' technology-integrated behaviours (§Chp.2). Moving from a theoretical definition of dispositions and their main components of beliefs (§Chp.2.1), self-efficacy (§Chp.2.2) and attitudes (§Chp.2.3), research evidence on their impact for technology integrated behaviours (particularly on a pre-service level) will be described.

Finally, *teacher reasoning* will be introduced as a possible key to make explicit tacit dispositions, professional knowledge and their connections, in the enactment of technology-integrated practices (§Chp.3). Moving from observable integrated behaviours (§Chp.3.1) and the concept of affordances (Pea, 1993), possible insights on teachers' adopted learning theories and professional reasoning could be inferred. Theoretical definitions and models for teacher reasoning will be introduced (§Chp.3.2), as well as empirical researches to develop such reasoning in pre-service teachers.

Concluding the section, Chapter 4 describes the rationale for the present study considering the multidimensional teacher competence emerging from the literature reviewed and the gaps in the research about efficient support of student-teachers' professional growth in relation to technology integration.

CHAPTER 1.
TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE AS FRAMEWORK FOR TEACHER KNOWLEDGE

Introduction

In the last decades, several educational policies around the world have explicitly included technology requirements in teachers' qualification processes (Eurydice, 2018; Punye, 2017; see also Ertmer, 2005; Koehler & Mishra, 2005a; Mouza et al., 2014), considering technology an active agent shaping educational practice (Voogt et al., 2016) and an essential knowledge and skill base for 21st century society (Tondeur et al., 2012). Sure enough, the presence of new technologies in education implies modifications in both its organization and content offer, with even considerable consequences on teaching practices (Heitink et al., 2016) and on theoretical reflection about the profession itself.

Theories like *Technology Mediation* and *Social Agency* (Voogt et al., 2016; Voogt & McKenney, 2017) postulate that technology and its users do not have a neutral relationship (Voogt et al., 2016), each part being active in shaping comprehension of the world. On this topic, Ihde (1993) defined different types of relationship between users and technology, while later authors made clear that the affordances of a specific technology depend on the actions of their users, in a complex and not straightforward relationship between the two (Voogt & McKenney, 2017; Webb & Cox, 2004). Within the domain of education, researchers like Britten and Cassady (2005; Harris, Grandgenett & Hofer, 2010), proposed a continuum in the relationship between teaching practices and technology uses. In their model, technology use can be non-essential, supportive or essential to the fulfilment of learning activities (Heitink et al., 2016), in a dynamic and co-shaped relationship between the two. Other researchers emphasize how teachers tend to apply innovations just to the extent in which it is congruent with their previous routine, thus neglecting technology's affordances (Voogt et al., 2016). It is therefore important to understand how teachers "give meaning to and use technology, what their motives and expectations are, which routines they develop and how technology direct their use" (Voogt et al., 2016, p. 46), in an effort to empower teachers' knowledge and professional awareness (Voogt & McKenney, 2017).

Overall, technologies are increasingly perceived as more than mere devices (Voogt et al., 2012), becoming real cognitive partners that amplify learners' capacity to understand, communicate and perceive (Angeli & Valanides, 2009, 2015; Ertmer & Ottenbreit-Leftwich, 2010), and that help in the activation of higher order cognitive processes (Kramarski & Michalsky, 2010). Considering the demands arising from educational policies and theories, it would seem that "effective teaching requires effective technology use" (Ertmer & Ottenbreit-Leftwich, 2010, p. 256). For technologies to be effectively integrated in teaching practice, though, teachers need to relate technologies' pedagogical affordances with their own pedagogical, content-related approaches (Angeli & Valanides, 2015; Chai, Koh, & Tsai, 2010), in the realization of a specific form of integrated professional knowledge.

This chapter provides an overview of the rise and development of a framework for such knowledge, identified as *Technological Pedagogical Content Knowledge* (TPCK). What follows is the result of a literature review on the main databases about *TPCK definition* and *TPCK and teacher education*, aimed at investigating the main strategies reported in the literature for identifying, enacting and supporting TPCK in teacher education (De Rossi & Trevisan, 2018). First, the appearance of this framework in academic research will be discussed considering its definition and main components (§Chp.1.1). Different interpretations will also be presented in their differences and commonalities. Finally, some of the main strategies reported in the literature for developing (§Chp.1.2) and assessing (§Chp.1.3) TPCK in student-teachers will be described.

1.1 TPCK AS FRAMEWORK FOR TEACHERS' KNOWLEDGE

Teacher knowledge is known to be extremely complex and multifaceted (Koehler & Mishra, 2005a), realized in the interaction among professional and personal knowledge (Ben-Peretz, 2011), and theoretical and practical understandings (Verloop, van Driel & Meijer, 2001). It is deemed as dynamic and situated in social, usually ill-defined contexts (Angeli & Valanides, 2009; Ben-Peretz, 2011; Harris & Hofer, 2009, 2011; Mishra & Koehler, 2006; Webb & Cox, 2004) in which different social subsystems shape such peculiar *wisdom of practice* (Shulman, 1986, p.11).

Although its definition has changed over time (see Ben-Peretz, 2011), a shared core has recently been found in the "interaction of the knowledge of representations of content matter with the understanding of specific learning difficulties and student perceptions related to the teaching of a particular topic" (Voogt et al., 2012, p. 113). This perspective had been advanced already by Shulman (1986, 1987), who saw in the teacher someone capable to integrate content knowledge with appropriate pedagogical approaches, so that learners could better understand the subject at stake. He summarized teachers' knowledge in the acronym *PCK*, standing for *Pedagogical Content Knowledge* (Shulman, 1986, 1987), which is now widely acknowledged as the distinctive body of knowledge for teaching (Voogt et al., 2012).

While Shulman's (1986) definition of *PCK* mentioned the media in the curricular knowledge section, relevant technology skills and knowledge were not further discussed (Ertmer & Ottenbreit-Leftwich, 2010; Graham, 2011). *Technological Pedagogical Content Knowledge* (TPCK) was thus introduced to identify the knowledge base for teachers to teach effectively with technology (Koehler & Mishra, 2005a; Voogt et al., 2012) and considered a "powerful mechanism to study and understand teacher cognition about the educational affordances of technology in teaching and learning" (Angeli, Valanides, & Christodoulou, 2016, p. 13). TPCK as an extension of PCK was the first interpretation offered in the literature (Voogt et al., 2012), by which the integration of the three knowledge domains (pedagogical approaches, subject-matter knowledge and technology knowledge) would reveal technology's potential for learning facilitation. TPCK's base components are:

1. *Technological Knowledge* (TK), that is knowledge of technologies and skills required to operate with them (Angeli & Valanides, 2009; Mishra & Koehler, 2006);

2. *Pedagogical Knowledge* (PK), related to teaching/learning processes and practices, methods and approaches (De Rossi, 2015; Mishra & Koehler, 2006); and

3. *Content Knowledge* (CK), that is teachers' understanding of a discipline's semantics and syntactic organization (Starkey, 2010) and its forms of content representation (Messina & De Rossi, 2015).

These bases then overlap in three areas of knowledge:

a. *Technological Pedagogical Knowledge* (TPK), which involves knowledge of technology's affordances and constraints for pedagogical purposes (Terpstra, 2015);

b. *Pedagogical Content Knowledge* (PCK), which, developing on Shulman's *PCK* (1986), focuses on the meaning of teaching a particular content viewed from the learners' perspective (Ben-Peretz, 2011; Mishra & Koehler, 2006); and

c. *Technological Content Knowledge* (TCK), as the understanding of which technologies are most suitable for a specific learning topic and how such topic could shape and determine technology uses, in turn (Mishra & Koehler, 2006).

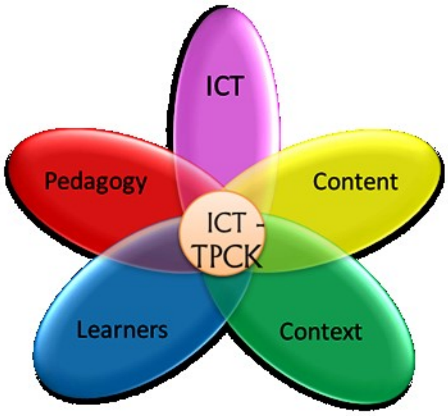
Finally, *Technological Pedagogical Content Knowledge* (TPCK) is the specific form of knowledge emergent from the conjunction of said base components. The core of the teaching profession requires an understanding of the best pedagogical approaches and concept representations using technologies in relation to students' prior knowledge and to possible content-related learning difficulties (Mishra & Koehler, 2006). Indeed, this teacher knowledge is deeply situated and sensitive to the *context* (Angeli & Valanides, 2009; Mishra & Koehler, 2006) as "teaching is a context-bound activity, and teachers with developed [TPCK] use technology to design learning experiences tailored for specific pedagogies, crafted for specific content, as instantiated in specific learning contexts" (Koehler et al., 2016, p. 22; see also Rosenberg & Koehler, 2014).

From the first introduction of the construct, multiple versions of TPCK acronym emerged, with different specifications. Already in 2008, Cox observed around a hundred significantly different definitions of TPCK constructs. Through a conceptual analysis of these, she helped clarifying the lexis with which to discuss the issue (see Cox & Graham, 2009), albeit not setting a clear line between and among the knowledge bases (Graham, 2011; Harris & Phillips. 2018). As Voogt (et al., 2012) reported, three are the main perspectives by which TPCK developed over time:

1. T(PCK) as an extended PCK, in specific understanding of technology's potential for learning facilitation. Angeli and Valanides, for example, proposed in 2005 the *PCK of*

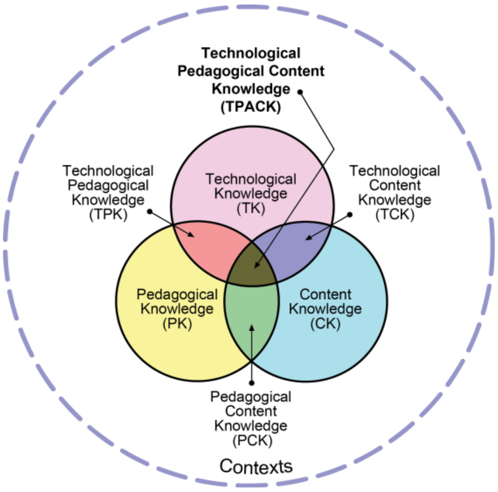
educational technology as knowledge "derived from and applicable to teaching and learning situations involving educational technology" (Angeli & Valanides, 2005, p. 294).

2. TPCK as a unique body of knowledge (Picture 1.1) that can be developed and assessed on its own, in a transformative perspective focused on situatedness and knowledge of learners (Angeli & Valanides, 2005; 2009). This perspective is supported by research evidence indicating that only when TPCK training is explicitly aimed at the development of a united construct, participants actually demonstrate adequate skills and knowledge in designing technology-enhanced learning activities (Angeli et al., 2016).



Picture 1.1 Main example of transformative Technological Pedagogical Content Knowledge (TPCK) - Angeli & Valanides (2009).

3. TP(A)CK (Picture 1) as the integration of the three knowledge domains and their intersections, in a situated perspective (Mishra & Koehler, 2006; Voogt et al., 2012). Here, the factors' interrelation would take place spontaneously during teaching practice (Angeli et al., 2016). Among the others, Guzey and Roehrig (2009) used this approach observing evidences of TK, PK, and CK to infer TPACK's existence, whereas Mouza and Wong (2009) used a similar procedure (then shifting to the transformative perspective) to claim that the combination of the single TPACK constructs indicates the very existence of TPACK.



Picture 1.2 Usual representation of Technological Pedagogical Content Knowledge (TPACK) – Credits: tpack.org.

The most significant framework modification was indeed the shift from TPCK to TPACK, standing for the *Total PACK-age* for teaching effectively with technology (Thompson, 2008). Still based on the three knowledge bases of TK, PK, and CK, it was considered easier to pronounce. This spelling modification is particularly important when considering the transformative (Angeli & Valanides, 2005) or integrative (Mishra & Koehler, 2006) perspective, as will be discussed shortly. Otherwise, the terms are to be considered as synonyms, as not every author has adopted the new phonetics (Voogt et al., 2012). Thus, the acronym TPCK will be used throughout the present dissertation, while TPACK will be mentioned only when explicitly reported in the sources[1].

The TPACK acronym was adopted, for example, by authors conceiving the framework as the integration of the three knowledge domains and their intersections, in a situated, integrative perspective, like Mishra and Koehler (2006). On the other hand, several researchers found it difficult to distinguish the boundaries and relations between and among the knowledge bases both in assessing and in developing TPCK (see also Graham, 2011; Voogt et al, 2012), and this has been one of the reasons why Angeli and Valanides (2005, 2009) proposed a different, transformative perspective. Considering TPCK a unique body of knowledge that can be developed and assessed on its own (Angeli et al., 2016), they continue using the original acronym TPCK. Finally, authors like Gess-Newsome (2002) propose a continuum instead of a dichotomy, among researchers' perspectives for integrative and transformative TPCK.

While the transformative viewpoint could help in understanding why TPCK boundaries are so difficult to trace in educational practices, the issue is still under discussion. A clear definition of TPCK's boundaries and their interaction seems to be a challenge that, if overcome, could help establish the validity and level of generalizability of the TPCK framework and related research (Angeli & Valanides, 2015; Graham, 2011; Angeli et al., 2016), so further research would be needed on this topic.

Different interpretations of TPCK

As mentioned, diverse interpretations and specifications of the construct emerged since the original identification of TPCK as a framework for teacher knowledge. In the attempt to clarify its structure, most researchers focus primarily on one or two of the model's components (Technology, Pedagogy or Content Knowledge) rather than devoting equal attention to all (see Table 1.1).

[1] This choice is valid for the whole dissertation.

Table 1.1 Interpretations of the TPCK framework as reviewed in the literature.

Reference	TP(A)CK framework specification			Overall perspective on the framework	
	Focus on Technologies	Focus on Pedagogy	Focus on Content	Integrative (TPACK)	Transformative (TPCK)
Angeli & Valanides (2006; 2009)	√				√
Lee & Tsai (2010)	√				
Wang (2008; 2009)	√				
Yeh et al. (2014)	√	√			√
Figg & Jaipal (2012)	√	√		√	
Benton-Borghi (2015)		√			
Chai, Koh & Tsai (2013)		√			
Kramarski & Michalsky (2015)		√			
Harris & Hofer (2011)		√	√	√	
Doering et al. (2009)			√	√	
Guerrero (2010)			√		
Jimoyannis (2010)			√		

On the technological front, Angeli and Valanides (2009) operated from a transformative perspective and proposed the *ICT-TPCK,* circumscribing TK only to ICT (see also Picture 1.1). These authors deem ICT-TPCK to support different learning styles by transforming content with multiple representations, using a variety of technological means so that learners and technology constitute a joint cognitive system (Angeli & Valanides, 2009). The *TPCK-W* proposed by Lee and Tsai (2010) considers the specificities of the Web 2.0 and teachers' perceptions of technology uses, while Wang (2008, 2009) suggests a *PST-TPCK* focused on technological affordances. Overall, these kind of theoretical interpretations of TPCK move from the consideration of technology's affordances to better define the boundaries of TPCK components, but carry the risk of a rigidity that might ignore the ever-changing technology's features (Messina & De Rossi, 2015).

The *TPACK – Practical* proposed by Yeh and colleagues (et al., 2014) acknowledges the importance of teaching experience in predicting teachers' TPACK proficiency (Angeli et al., 2016; Jang & Tsai, 2012), focusing the model on both ICT understanding and content knowledge. The *TPCK – in – Practice* suggested by Figg and Jaipal (2012) defines TPCK as the knowledge emerging from the infusion of TK into PCK (Jaipal-Jamani & Figg, 2015), and involving the understanding of a technology-enhanced, content-specific activity-types repertoire. This interest in teaching practice could help to close the gap between theoretical definitions and concrete teaching evidence (especially in consideration of the specific educational contexts) but presents the issue of analysing and generalizing the latter in a clarification of the former.

On the Pedagogical side of TPCK, the *Technological Learning Content Knowledge* (*TLCK)* offered by Chai and colleagues (Chai, Koh & Tsai, 2013) considers primarily the learning processes connected to the uses of technology within a specific discipline (Messina, 2015). The *Universal Design for Learning – TPCK* (*UDL – TPCK)* proposed by Benton-Borghi in 2015 concentrates on pedagogical strategies enabled by technologies: their multimodal affordances would meet the needs of the *UDL* reinforcing equity and inclusion (Benton-Borghi, 2015). *TLCK* and *UDL - TPCK* are examples of more learner-centred interpretations of TPCK, opening interesting lines of research that may have extensive implications for the design of teacher education courses.

Finally, various interpretations of TPCK have been applied to the different disciplines. Examples include Doering et al.'s *G-TPACK* (2009) applied to technologies for geographic learning, Guerrero's (2010) *TPACK for mathematics* (see Voogt et al., 2012), and Jimoyannis' *TPASK* (*Technological Pedagogical Science Knowledge*; 2010). This line of content-related specification of TPCK could also help in bridging TPCK's theoretical definition with practical demands, but some authors observe an unequal distribution of studies on mainly scientific-related disciplines (Chai et al., 2013). According to them, this would "reinforce the opinion that the use of technology is more akin to the mathematics and science subjects" (p. 44).

1.2 Developing teachers' knowledge with TPCK

Along with the diverse theoretical interpretations, several strategies are reported in the literature to detect and support the development of TPCK (see Table 1.2). Niess (2005) suggests that TPCK development involves attitudinal change, acquisition of technological skills, and creation of pedagogical ideas for technology integration (see also Voogt et al., 2012). The author argues that TPCK development needs to be based on four components (Niess, 2015):

(a) an overarching understanding of purposes for embedding technology in subject matter teaching;
(b) knowledge of students' understanding, thinking and learning with technology in that subject;
(c) knowledge of curriculum and curricular materials in a particular subject, related to technology integration in learning and teaching; and
(d) knowledge of instructional strategies and representations for teaching and learning a specific topic with technology (Niess, 2015; Voogt et al., 2012).

Table 1.2 Strategies reported in the literature to develop and assess TPCK (see De Rossi & Trevisan, 2018).

Reference	Study design	Strategies to develop TP(A)CK				Strategies to assess TP(A)CK		
		Focus on Instructional Design	**Focus on Discipline Content**	**Focus on Technologies**	**Organization of integrated educational courses**	**Self-assessment (surveys, questionnaires)**	**Interviews**	**Performance observation / product assessment**
Angeli & Valanides (2013)	Design- based Research	√		√				√
Chien et al. (2012)	Design – based Research	√						√
Forkosh-Baruch (2018)	Theoretical	√	√	√	√			
Harris, Grandgenett & Hofer (2010)	Rubric	√						
Harris & Hofer (2009, 2011)	Case study	√					√	√
Hofer & Grandgenett (2012)	Rubric	√			√			√
Koehler & Mishra (2005a; 2005b)	Case study	√					√	√
Koh & Chai (2014)	Design – based Research	√				√		
Koh & Divaharan (2011)	Case study	√		√				
Mishra, Peruski & Koehler (2007)	Case study	√					√	√
Hammond & Manfra (2009)	Case study		√					
Khan (2011)	Case study		√					
Niess (2005)	Case study		√		√			
Mouza et al. (2015)	Longitudinal study				√			
Tondeur et al. (2012; 2016)	Theoretical				√			
Archambault & Barnett (2010)	Design- based Research					√		
Hsu et al. (2013)	Survey					√		
Jang & Tsai (2012)	Design – based Research					√		
Koh, 2013	Rubric					√		√
Krauskopf et al. (2012)	Survey					√		
Lee & Tsai (2010)	Survey					√		
Papanastasiou & Angeli (2008)	Design – based Research					√		
Schmidt et al. (2009)	Survey					√		
Yilmaz-Ozden, Mouza & Shinas (2016)	Survey					√		
Jaipal & Figg (2010)	Theoretical						√	
Ozgün-Koca (2009)	Case study						√	
Williams, Foulger & Wetzel (2010)	Design – based research						√	
Britten & Cassady (2005)	Survey							√
Chai et al. (2010)	Theoretical							√

1.2.1 Strategies to develop TPCK: focus on design

The first strategic line to develop TPCK among pre-service teachers here reported is active engagement in design cycles (Table 1.2). Koehler and Mishra (2005b) point out the importance to provide pre-service teachers with technology-rich lessons as opportunities for dialogue and interactions in which TPCK's components are developed concurrently (see Kramarski & Michalsky, 2010). Baran and Uygun (2016) suggest that the design process, especially if supported by reflection, offers meaningful opportunities to show explicitly how technology, pedagogy, content, and contextual factors mutually reinforce/constrain each other.

Koehler and Mishra (2005a, 2005b) developed the *Learning Technology By Design* approach, meant to encourage teachers to develop technological solutions to authentic pedagogical problems (Mouza et al., 2014). They interviewed the participants engaged in collaborative design, observing significant development in their TPACK, within an integrative perspective. Similarly, Koh and Chai (2014) found pre-service teachers' engagement in design processes to have a positive influence on TPK and TCK perceptions, fostering their overall TPACK. They used self-reported TPACK measures, which suggested that participants involved in ICT-based lesson design deepened the connections among TPK, TCK and TPACK.

Moreover, Harris and Hofer (2009, 2011), deeming technology-enhanced instructional design to be content-focused, context-sensitive, and activity-based, propose a taxonomy of activity-types matched with technology choices based on the implied forms of knowledge (*LAT).* LAT is intended as a methodological shorthand to build and describe learning plans (Harris & Hofer, 2009). The authors engaged pre-service teachers in LAT-related design tasks and observed through interviews and product analysis that participants grew more conscious of the multiple options available for technology-enhanced learning activities, and are therefore more likely to incorporate technologies into their instructional design. Chien and colleagues (et al., 2012) propose four steps for assisting science teacher educators in linking technology and instructional design, transforming pre-service teachers into active designers of technology-enhanced learning environments. Through analysis of design products, they found significant growth in pre-service teachers' technology competence levels and in critical examination of pedagogical affordances.

A limitation of the reviewed studies is their strong contextualization, as several of them are case studies implementing mainly highly context-sensitive qualitative instruments (Baran & Uygun, 2016). Further validation and replication of the research procedures would be encouraged to better understand the most useful approaches for developing teachers' effective technology-enhanced design and supporting their TPCK development (Baran & Uygun, 2016; Mouza et al., 2014).

1.2.2 Strategies to develop TPCK: focus on the content

Other studies focused on TPCK development within a specific disciplinary area (see Table 1.2) enacting the framework's demand for situatedness (Angeli & Valanides, 2009; Mishra & Koehler, 2006) within an authentic professional context. One example is Niess' work (2005) on TPCK development in pre-service mathematics teachers. She proposed TPCK standards and subject-related indicators in four areas:

(a) design/development of technology-related environments;
(b) application of technology-related strategies to maximize student learning;
(c) application of technology in assessment; and
(d) use of technology to enhance teachers' productivity and practices (Voogt et al., 2012).

Khan (2011) also dealt with science teachers and demonstrated how pedagogy and technology were jointly used to support students in learning chemistry, using a generate-evaluate-modify approach in their case study.

Although TPCK's disciplinary declinations and investigations are mainly set in the area of sciences (Chai et al., 2013), studies like Hammond and Manfra's (2009) operated with social-studies teachers to foster their planning of instruction with technology. Starting from the specific content to teach (PCK), and only later considering technology uses, they used TPCK as a common language for discussing technology integration in instruction.

These researches posed an interesting question on TPCK definition, in terms of content specificity: while Hammond and Manfra (2009) saw TPCK as not particularly subject specific, but rather a broad strategy to extend PCK to comprise technologies, other authors like Jimoyannis (2010) and Guerrero (2010) detailed TPCK specifically for single disciplines. As mentioned earlier, TPCK's theoretical definition as a whole is still under discussion, and the extent of discipline specifics in relation to a more comprehensive definition of teacher knowledge is an interesting line of research to pursue.

1.2.3 Strategies to develop TPCK: focus on technology

Other studies focus on the technological side of TPCK development, having a common strategy in providing pre-service teachers with technology courses (Mouza et al., 2014), either addressing awareness of technological affordances (Angeli & Valanides, 2009; 2013) or teachers' technical proficiency (Koh & Divaharan, 2011). Technology courses have been found to foster teachers' self-efficacy in technological skills, but do not seem decisive in developing their TPCK altogether (Mouza et al., 2014).

In a systemic consideration of technology, pedagogy and content, Angeli and Valanides (2009, 2013) proposed the *Technology Mapping (TM)* approach to TPCK development, based on mapping tool affordances to align student-teachers' PCK with their knowledge about ICT. The authors engaged pre-service teachers in authentic design tasks, using TM as situated guide to teachers' thinking processes, evaluating their products. The authors offer seven instructional design guidelines to facilitate the enactment of the TM process[1] and realize, for each design task, three forms of assessment, namely expert, peer, and self-assessment (Angeli & Valanides, 2009; Voogt et al., 2012).

Koh and Divaharan (2011) and Niess (2015), starting from the assumption that teachers first need to be comfortable with ICT as users before being ready to use it as teachers, proposed a *TPACK developing instructional model* that encompasses confidence building, subject-focused pedagogical modelling, and hands-on application.

While the mentioned approaches offer interesting findings, they are focused on specific technological tools (e.g. Excel and Interactive Whiteboards), highlighting the need of further examples with different tools to gain validation.

1.2.4 Strategies to develop TPCK: organization of educational courses

Other strategies to foster TPCK development can be found in the specific organization of educational courses for pre-service teachers. Mouza (2016) reviewed the most widely reported strategies and pointed out three main pathways:

(a) stand-alone educational technology courses;
(b) instructional strategies embedded within an educational technology course or content-specific method course; and

[1] Technology mapping, meant to be "about making the educational affordances of the tools explicit whining the context of an authentic design task, while student-teachers learn how to use technology itself" (Angeli & Valanides, 2013, p. 207) is ideally enacted through (1) discussion on educational affordances of a tool related to a specific group of pupils; (2) demonstration of said affordances with a completed design task; (3) discussion and explanation of the structure of said design product; (4) hands-on practice with the affordances within a new design task; (5) repetition of steps 2-4 gradually moving from completed to semi-completed to new design tasks; (6) introduction of new educational affordances of the tool and repetition of steps 2-5 until every affordance is introduced, explained and practiced; and (7) selection of a new tool and repetition of steps 1-6.

(c) instructional strategies implemented in the entire curriculum of teacher education, like the ones carried out by Niess (2005), Hofer and Grandgenett (2012), or Mouza and colleagues (et al., 2015).

Forkosh-Baruch (2018) reviewed preservice education programmes around the world regarding the different strategies to support teachers' ICT integration, and reports that the best impact is given by a dynamic nature of the training processes, which should begin as technological, then focus on pedagogical and disciplinary opportunities for innovation. Auspicating for the definition of shared approaches to teachers' ICT integration education, she recommends several actions. First, (1) an attention to the affective state: "preservice teachers' attitudes and beliefs regarding ICT may indicate the extent and quality of ICT utilization" (Forkosh-Baruch, 2018, p.427). Thus, it is essential to engage them and strive for the creation of positive beliefs on ICT as (2) transformative means to educational practice. A high level of (3) flexibility and variety of ICT-based training, declined for the specific institute and teachers/pupils' population is warranted, always showing a (4) clear role of teachers in today's technology-rich society. Teachers' training should be (5) practice-related in a "holistic pedagogical master plan for ICT integration" (p.428) that considers teachers' (6) technological skills as prerequisites, and (7) instructional curricular design as main focus. Finally, (8) preservice education should promote sustainable and scalable ICT integrated practices, engaging in (9) modelling sessions with both faculty and trainees as co-learners, and being (10) continuously evaluated on its quality (Forkosh-Baruch, 2018).

Through the review of several qualitative studies, Tondeur and colleagues (et al., 2012, 2016) defined an SQD–model to analyse and assess educational programs for pre-service teachers in supporting TPCK development. They identified different strategies on the micro-level (e.g., using teacher educators as role models, learning technology by design, scaffolding), and conditions necessary at the institutional level (namely, technology planning and leadership, cooperation within and between institutions, staff training). Although their model has been validated only on the micro-level so far (Tondeur et al., 2016a), it poses as an interesting strategy for investigating the quality of higher education programs for developing pre-service teachers' TPCK.

1.3 RESEARCH ON TPCK INVESTIGATION AND ASSESSMENT

Along with strategies for TPCK development, literature offers also instruments to investigate and assess it altogether. In the following paragraphs, the main instruments to assess and investigate TPCK in pre-service education will be introduced, as revealed by the reviewed literature. Findings will be organized in the following macro-categories: self-assessment (surveys, questionnaires, self-reports), and interviews and performance observation (see Table 1.2).

1.3.1 Self-assessment

Self-assessment is one of the most commonly reported strategies to investigate TPCK. For example, Schmidt et al.'s (2009) one, with its seven-factor analysis for different subject areas, which was found to be useful in detecting teachers' TPCK level and dimensions from an integrative perspective (Abbitt, 2011). Adaptations of this survey can be found in Chai's study (Chai et al., 2010), whose findings indicate that construct validity for the seven TPACK factors, taken as a whole, proves problematic. The *Survey of Teaching Knowledge with Curriculum-Based Technology* proposed by Yilmaz-Ozden, and colleagues (Yilmaz-Ozden, Mouza & Shinas, 2016) was found to be a valid and reliable reorganization of Schmidt et al.'s (2009) survey, while its implementation suggested that it would be useful to consider TPCK from a transformative perspective.

Archambault and Barnett (2010) proposed a survey with 24 items to assess the seven TPACK factors, coming to the conclusion, though, that these theorized bases could not be reflected in practice. The same conclusion was reached by the implementation of Lee and Tsai's (2010) survey based on six factors for web-based learning. Several of these instruments, starting with Schmidt et al.'s one (2009), present evidence that teachers may not be consciously considering as separate the knowledge areas that in theory are distinct – TK, PK, CK, TPK, TCK - even if overlapping (Chai et al., 2010; Chai, Koh & Tsai, 2016; Cox & Graham, 2009; Mouza, 2016). Once again, the gap between theoretical definition and practical measurements calls for further reflection on TPCK as a framework.

Other surveys dealt with specific TPCK interpretations, such as the one proposed by Hsu and colleagues (et al., 2013) on *game-based TPACK*, or Krauskopf and colleagues' one (Krauskopf, Zahn & Hesse, 2012) on TPACK for the use of educational videos. Jang and Tsai (2012) developed a questionnaire with the aim to identify CK and TK as distinctive factors, while creating a *PCK - context* factor from the joining of PK, PCK and the context factors.

Finally, Papanastasiou and Angeli (2008) created a survey to examine which factors might impede teachers' efforts to teach with technology. The survey, whose reliability was found sufficiently high (Papanastasiou and Angeli, 2008), considered six main factors: teachers' (a) knowledge of technology tools, (b) frequency of personal technology use, (c) frequency of instructional-related technology use, (d) attitudes toward technology, self-confidence in instructional technology use, and (f) school climate.

1.3.2 Performance observation and assessment

Another strategy to investigate TPCK development is through performance observation and assessment (see Table 1.2), one of its earliest examples being Koehler and Mishra's (2005b). They studied and assessed, through the analysis of authentic design-based activities, the evolution of participants' learning and perceptions about: (a) the learning environment; (b) knowledge of technology; (c) course content; and (d) TPACK (Mishra & Koehler, 2006). In a later study, Mishra and colleagues (Mishra, Peruski & Koehler, 2007) analysed design teams' conversations by monitoring the frequency of the seven knowledge domains. The distinction in TPACK sub-domains was adopted also in Bowers and Stephens' rubric to assess TPCK through student-teachers' performances (Bowers & Stephens, 2011; Voogt et al., 2012).

One of the most widely used instruments to assess performance is indeed the rubric. For example, Harris and colleagues (Harris et al., 2010) created the *TPACK-based Technology Integration Assessment Rubric (TIAR)* based on Britten and Cassady's (2005) *Technology Integration Assessment Instrument* (TIAI). TIAR was used in a longitudinal study of pre-service teachers, involving lesson plans assessment in terms of TPK, TCK, and TPACK (Hofer & Grandgenett, 2012) and includes four dimensions: (1) curriculum goals and technologies; (2) instructional strategies and technologies; (3) technology section; (4) *fit* of content, pedagogy and technology (Mouza, 2016). Furthermore, the authors adapted such rubric to develop the *Technology Integration Observation Instrument*, which was found to be valid and reliable in assessing TPCK enactment in pre-service contexts (Harris et al., 2010).

The evaluation of design products is also at the centre of the rating scale developed by Angeli and Valanides (2005) to assess pre-service teachers' technology-enhanced learning design for *ICT-TPCK*, which considered (a) selection of appropriate topics; (b) identification of technological representations of the content; (c) identification of teaching strategies; (d) design of computer-based learning activities; (e) identification of integrated activities (Angeli & Valanides, 2009).

Mouza (et al., 2014) looked for evidence of TPACK in teachers' artifacts through case narratives while Koh (2013) proposed a rubric highlighting how meaningful content learning needs adequate support from ICT, in consideration also of Harris and Hofer's (2009, 2011) forms of knowledge. In another work, Chai et al., (2010) reframed this rubric to help scaffolding teachers' transition toward constructivist-oriented ICT integration. Their rubric comprises five dimensions related to meaningful learning with ICT: (1) Active (related to the time spent by students in using/manipulating ICT tools); (2) Constructive (related to divergent and personally reflective knowledge expressions); (3) Authentic (in the capability to enable connections between the subject matter and the real-world experiences); (4) Intentional (related to the opportunities for students to engage in continual self-diagnosis and remediation of learning gaps); and (5) Cooperative (about the stimulation of divergent talk) (Koh, 2013).

Finally, Mishra and colleagues (et al., 2007) used interviews to observe the ways faculty members integrate new technologies in content-related pedagogical practices. As a result, they found evidence of complex and conscious reasoning among the faculty members about the relationships among the content, pedagogy and technology domains. Along the same lines, Williams, Foulger and Wetzel (2010) and Jaipal and Figg (2010) tried to map TPACK domains through interviews among faculty and pre-service teachers. Another example can be found in Ozgün-Koca's (2009) work with pre-service mathematics teachers, interviewed about their beliefs on visual and transformational technological tools for teaching their subject.

The reviewed examples of performance observation and assessment use valuable instruments to examine the meaningful use of technology in teaching practice (Archambault, 2016), but maintain heavy contextual bounds that hinder data generalization and call for additional research on the use of the TPCK framework in different learning settings and content areas (Archambault, 2016; Koh, 2013).

Conclusions

TPCK has proved an interesting lens for researchers to investigate teachers' meaningful use of technology in their practice (Archambault, 2016; Harris et al., 2010), offering both teacher educators and policymakers the possibility to analyze and reflect upon technology-integrated planning (Archambault, 2016; Mouza & Karchmer-Klein, 2013).

This chapter reported on several articles on the introduction and development of the TPCK framework for teachers' knowledge as a response to the changing role of technology in educational practices during the last decades. TPCK's theoretical definition and main components have been described, along with the later interpretations and the main strategies for its development and assessment in teacher education. Although this review tried to embrace different perspectives as retrieved in accredited studies, academic discussion and research on the topic are particularly active, so further study would be encouraged, especially in the strategies of TPCK operationalization in pre-service education.

In particular, TPCK's theoretical boundaries are still to be specified and verified, with consequences for its definition and measurements. There is a need to understand better how to foster its development in pre-service teacher education (Cox & Graham, 2009) as the documented methods and approaches are varied, making it difficult to compare the outcomes (Mouza, 2016). Data generalization is a major challenge for research on TPCK, which is usually heavily contextually bound (Archambault, 2016), and calls for more validated qualitative and quantitative instruments in the different disciplinary areas to map TPCK development trajectories (Chai et al., 2016).

CHAPTER 2.
TEACHERS' DISPOSITIONS FOR TECHNOLOGY INTEGRATION

Introduction

Teacher competencies on teaching and learning with technologies are not limited to knowledge and technical skills. As an example, while TPCK proficiency may be an effective enabler for technology integration, it alone cannot account for the different actual practices in place (Hall, 2010; Niederhauser & Lindstrom, 2018). Literature has long shown the relevance of non-rational psychological domains in shaping teacher behaviour for technology integration (Knezek & Christensen, 2018; Smart, 2016; Voogt et al., 2012).

The following section will focus on this non-rational, affective dimension (Ertmer, 2005; Knezek & Christensen, 2018) that helps forge technology integration practices, going under the name of *dispositions* (Christensen & Knezek, 2018; Harris et al., 2017; Niederhauser & Lindstrom, 2018; Ottenbreit-Leftwich, Kopcha & Ertmer, 2018). These can be identified in internal factors like core attitudes and beliefs which contribute to shape decisions and behaviours (Allen, Wasicsko & Chirichello, 2014; Wasicsko, 2007), as will be described shortly.

Researchers found that the sometimes observed gap between teachers' (perceived) knowledge and skills on technology, and the actual ICT integration in practice (Hall, 2010) could be referred back to the filter or barrier action of non-rational elements like beliefs and attitudes (Crompton, 2015; Ertmer, 1999; Niess, 2011). For example, Kim and colleagues (et al., 2013) indicated how teachers' beliefs can predict, reflect, but also hinder and interfere with technology integration. Intrapersonal beliefs are found to highly influence teachers' technology acceptance and integration (Niederhauser & Lindstrom, 2018) as teachers often tend to adopt and integrate technologies in ways that are consistent with their personal beliefs about curriculum and instructional practices (Ertmer, 2005).

Several theoretical models try to organize systemically the matter: for example, the *Theory of Planned Behaviour* (Ajzen, 2012) clearly indicated beliefs and attitudes as predictors of behaviour. Stemming from here, the *Technology Acceptance Model* (TAM) was among the first models to examine specifically technology acceptance behaviours in relation to perceived ease of use, usefulness, attitude toward computer use, and intention to use technology (Davis, Bagozzi & Warshaw, 1989). Today, the *Will Skill Tool Pedagogy* (WSTP – Knezek & Christensen, 2016) is one of the most comprehensive models to observe technology integration in teaching practices

(Niederhauser & Lindstrom, 2018). Results from related researches show how these constructs, comprising knowledge (primarily in *Skill* and *Pedagogy*) along with non-rational aspects (e.g. motivation and attitudes in *Will*), explain up to 90% of teachers' technology integration practices (Christensen & Knezek, 2009; Knezek & Christensen, 2016). A slightly modified version of such model is *WEST – Will Experience Skill Tool* suggested by Farjon, Smits and Voogt (2019). These authors investigated 398 pre-service teachers looking for technological attitudes and beliefs, experiences, competency and accessibility to technologies, and found that the dispositional factors (i.e. attitudes and beliefs, within *Will*) were the strongest predictors on technology integration, while access (in *Tool*) was the weakest. *Experience,* on the other hand, identified as the quantity and quality of first-hand experiences with technology integration in education (Farjon et al., 2019, p. 84) reported only limited relevance on influencing pre-service teachers' integrated practices.

The connection between ICT – related knowledge and dispositions in teachers has been long studied, with results suggesting that teachers' pedagogical beliefs might grow as they become more knowledgeable in using ICT (Ertmer & Ottenbreit-Leftwich, 2010). Howard and Gigliotti (2016) studied the relationship between ICT – related knowledge and attitudes with similar findings, while Petko (2012) and Karaca (Karaca, Can & Yildirim, 2013) indicated how teachers' ICT uses can be predicted by both the teachers' beliefs and competency feelings (Petko, 2012), and attitudes (Karaca et al., 2013; Ertmer, 2005).

The paragraphs below address the non-rational dimension of teacher competence through the construct of dispositions (Christensen & Knezek, 2018; Harris et al., 2017; Niederhauser & Lindstrom, 2018), seen as a complex set of "interrelated internal constructs that work together with knowledge to form and manifest specific behaviours" (Ottenbreit-Leftwich et al., 2018, p. 327). A brief contextualization and definition of the term in the literature is offered, then the text will delve into its aspects like beliefs and attitudes. Even though these constructs are deeply intertwined, for an easier reading they will be described here separately. Each one will be presented with a theoretical definition as from current literature and some research instruments and evidence regarding its connection with ICT integration in teaching practices.

Teachers dispositions

Dispositions comprehend a wide range of intrapersonal characteristics contributing to decisional processes and actual behaviours (Niederhauser & Perkmen, 2008). To quote one among the several definitions, Allen and colleagues (Allen et al., 2014) identify dispositions in “a person’s core attitudes, values and beliefs demonstrated through both verbal and non-verbal behaviours as one interacts with oneself, others, one’s purpose, and frames of reference” (p. 2). When it comes to teachers, it is particularly important to consider dispositions about ICT integration, to better support pre-service and in-service professional development.

Dispositions to accept or avoid change, anxiety, attitudes, pedagogical beliefs, perceived usefulness of ICT in education, and self-efficacy are found to influence strongly technology integration practices (Ertmer, 2005; Hew and Brush, 2007). Research on such influence is wide and thorough (e.g. see Christensen & Knezek, 2018; Rizhaupt et al., 2017), although there is not a univocal agreement on the theoretical categorization of dispositions overall (Ottenbreit-Leftwich et al., 2018). While it is now commonly shared that concepts like beliefs, attitudes, self-efficacy and anxiety, for example, belong to the broad box of dispositions, scholars disagree on the specific relations among one another. For the purpose of this dissertation, Wasicsko (2007) and Ottenbreit-Leftwich’s (et al., 2018) descriptions of dispositional factors associated with teachers’ adoption and uses of ICT will be considered. Wasicsko (2007) reports on three constructs within teacher dispositions: (a) teacher perceptions as core values and beliefs; (b) teacher consistent characteristics, as attitudes; and (c) teacher observable behaviours as outliers of internal characteristics. Ottenbreit-Leftwich and colleagues (et al., 2018) consider four primary dispositional factors:

- Pedagogical beliefs about teaching and learning (and ICT’s role in these processes);
- Openness to change, as willingness to incorporate new technologies or approaches to teaching with technologies;
- Self-efficacy, as one’s own perception of capability in using ICT for teaching and learning; and
- Attitudes and subjective norms as value attributed to ICT use in education.

Considering current research on the topic and the aims of this research, in the next paragraphs the reader will find the description of teacher dispositions about ICT integration in terms of core values and beliefs (i.e. pedagogical beliefs, openness to change – §Chp.2.1), self-efficacy (§Chp.2.2) and attitudes (§Chp.2.3). Each construct definition based on current literature will be introduced, along with some relevant research evidence on the topic. Again, it is to bear in mind that although described here individually, these constructs are all part of the bigger, intertwined system of dispositions.

2.1 Core values and beliefs

Technology adoption and integration in education is highly influenced by the underlying beliefs about ICT value and usefulness in such contexts, sometimes even more than by technologies' affordances, or even despite them (Ertmer & Ottenbreit-Leftwich, 2010; Voogt et al., 2012).

When observing teachers' beliefs and actions, research findings are twofold: some suggest that teachers' enact practices closely reflecting their beliefs (Ertmer et al., 2012; Harris et al., 2017; Kim et al., 2013; Prestridge, 2012; Starkey 2011) others notice a gap between beliefs and practices (Chai, 2010; Hall, 2010; Heitink et al., 2016; Liu, 2011; Niederhauser & Lindstrom, 2018). This may have some explanation in the intrinsic structure of belief systems, as described by different theoretical models. Just as an example, there are two theories that could be seen as extremes to a continuum. Thagard's (2000) *Coherence Theory of Justifications* states that beliefs emerge and develop in the logic of coherence and support with pre-existent beliefs (see also Kim, 2016). Here, when a contradiction is noticed, individuals will adjust their system of beliefs to avoid overt contradictions (Leatham, 2006; Singletary, 2012). This perspective could well explain how general beliefs (e.g. pedagogical ones) could be reflected in specific ICT integration beliefs, and thus in practices (Ertmer, 2005; Kim et al., 2013).

On the other hand, Green (1971) suggested that beliefs develop in relatively autonomous clusters that allow conflicting beliefs, if in different clusters (e.g. beliefs about teaching and learning could not be related, in an individual's system of beliefs, with ICT related ones). In this case, an explanation could be found for ICT integration practices that do not seem to reflect teachers' declared beliefs. The present dissertation is not concerned with investigating belief systems' generation or categorization, but theories like the ones just mentioned could help better interpret emerging data.

Regardless of the relations among (clusters of) beliefs, the ones dealing with teaching and learning perceptions (i.e. *pedagogical beliefs*) are widely recognized to function as filters (Niess, 2011; Niess & Gillow-Wiles, 2017) or enablers (Ertmer, 2005; Hew & Brush, 2007) when it comes to teachers' ICT integration, along with *openness to change* and its opposite *resistance* to change (Ottenbreit-Leftwich et al., 2018).

2.1.1 Pedagogical beliefs

With pedagogical beliefs the present research refers to "teachers' educational beliefs about teaching and learning" (Ertmer, 2005, p. 28), usually observed in a spectrum from teacher-centred, traditional beliefs, to learner-centred, constructivist ones (Ertmer & Ottenbreit-Leftwich, 2010; Kim, 2016; Knezek & Christensen, 2018). Within this perspective, the present research focuses on ICT related traditional to constructivist pedagogical beliefs (Agyei & Voogt, 2011) and how they inform teaching practices.

Looking at the extent of ICT integration in teaching practices, many researches point to its positive relation to constructivist beliefs over traditional ones (Ertmer et al., 2012; Kim et al., 2013; Sang et al., 2010). Teachers with more constructivist, learner-centred pedagogical beliefs are found to be more likely to extensively use technologies in their classrooms when compared to teachers holding more traditional beliefs (Kim et al., 2013; Overbay et al., 2010; Sang et al., 2010). Furthermore, research findings suggest how teacher-centred ICT beliefs usually are reflected in lower-level ICT uses (Dwyer et al., 1994; Judson, 2006; Roehrig, Kruse & Kem, 2007), focused on drills, lecturing or information access, e.g. through skill-based software (Chai, 2010; Ertmer et al., 2012; Kim et al., 2013). On the other hand, teachers with more learner-centred ICT beliefs are often found to enact higher-order thinking level ICT uses (Dwyer et al., 1994; Judson, 2006; Roehrig et al., 2007) through the use of open-ended software (Ertmer et al., 2012; Kim et al., 2013; Niederhauser & Stoddart, 2001).

Teachers' beliefs about learning are also found to be associated with their TPCK (e.g. Kramarski & Michalsky, 2009, 2010) and understanding preservice teachers' beliefs in relation to their TPCK could indeed be a powerful means to provide effective education programs fostering meaningful technology integration practices (Chai et al., 2013; Voogt et al., 2012). Kim (2016), for example, observed that student-teachers with more sophisticated beliefs (i.e. constructivist) about mathematics, learning, and technology, held higher CK, PCK, and TCK levels (see also Smith, Kim & McIntyre, 2015). Chai (et al., 2013) found a significant relation among all TPCK components and constructivist-oriented pedagogical beliefs, whereas traditional ones were not associated with PCK. Abbitt's (2011) study reports how preservice teachers' beliefs about their technology integration capabilities were strongly associated with their TPK, TCK and TPCK, although in studies like Kim's (2016) no clear relationship between TPCK and technology beliefs was shown. This goes back to the issue of teachers' declared pedagogical beliefs not always aligning with their practices (Liu 2011, Shifflet & Weilbacher, 2015). This might also be due to a barrier effect (Ertmer, 2005) as the one reported by Crompton (2015). Some beliefs might indeed hinder pre-service teachers' use of technology, like the lack of confidence in their abilities to use technologies; the belief that teachers' competence might be undermined by students' technological proficiency; or the insecurity deriving from the use of technology to teach subject matters in ways that don't match with how pre-service teachers learnt them back at school (Crompton, 2015).

On the other hand, several researches examining pedagogical beliefs and technology practices with observation and interviews found that pedagogical beliefs and technology practices did align (Forkosh-Baruch, 2018; Kim et al. 2013; Prestridge 2012).

Investigating how teachers' dispositions affect their decision-making processes and practices in using technology (Voogt et al., 2012) is quite difficult to do, considering that beliefs exist primarily as tacit (Ertmer, 2005). Nevertheless, trying to expose them and investigate alignments and gaps with practices is crucial, as it was proven that pedagogical beliefs are "critical underliers to teachers' resistance to change" (Kim, 2016, p. 15) like will be discussed shortly.

On the teacher education side, some studies observe how to support pre-service teachers in developing learner-centred beliefs exposing them to constructivist theories is not enough (Lim & Chan, 2007). Many suggest help pre-service teachers to identify their perceived barriers to constructivist instruction, in order to foster the shift from traditional to constructivist beliefs (Lim & Chan, 2007; Ottenbreit-Leftwich et al., 2018). On this line, Ertmer (2005) proposed three main strategies to promote positive technology related pedagogical beliefs: (a) personal experiences, (b) vicarious experiences, and (c) socio-cultural influences, especially in terms of professional expectations.

Research findings show how the more content-specific technology examples are given to teachers, the more likely they will see value in them and enact technology integration, and the more motivated they will be to experiment with additional technologies in their teaching (Ertmer & Ottenbreit-Leftwich, 2010).

2.1.2 Openness and resistance to change

Openness to change can be identified in the "willingness to try new instructional innovations and take risks in teaching" (Baylor and Ritchie, 2002, p. 399), committing time and effort in a risk-taking attitude to the task (Vannatta and Fordham, 2004). Opposite to that, there is *resistance to change* (Mathipa and Mukhari, 2014), which has been found to be a powerful predictor to negative attitudes development toward ICT uses.

It is quite intuitive how a positive willingness towards ICT use would enable actual technology use (see the *Theory of Planned Behaviour* – Ajzen, 2012), and researches have proven that openness to change has actual significant relations, e.g., with ICT frequency of use in the classroom (Agyei & Voogt, 2011; Ottenbreit-Leftwich et al., 2018), or with teachers' abilities to integrate ICT (Forkosh-Baruch, 2018; Knezek & Christensen, 2018). Studies like Aldunate and Nussbaum's (2013) reported how the less willing (i.e. less open) to integrate technologies the teachers, the more likely they were to abandon their integration efforts whenever a technical issue came up. Interestingly, Kimmons and Hall (2016) found that the teachers' resistance to change could be dealing primarily to the perception of technology's (lack of) usefulness in relation to student learning goals, stressing the role of pedagogical beliefs. This accounts once again for the intertwined system in which each of the constructs presented in this chapter is immersed. Furthermore, it points out how openness/resistance to change is linked to the perception of *technology usefulness*, which is widely reported in the literature (Kimmons & Hall, 2016; Ottenbreit-Leftwich et al., 2018; Joo, Park & Lim, 2018).

Within the domain of teacher education, it seems that the context in its educational culture and specific strategies (e.g. hands-on tasks) might foster a more open approach to technology integration (Baran et al., 2019; Mouza et al., 2014; Scherer et al., 2018; Tondeur et al., 2017, 2019; Tondeur, Valcke & Van Braak, 2008).

2.2 Self-efficacy

Self-efficacy, based on Bandura's *Social Development Theory* (1986) as an expression of individual beliefs of being capable to perform a certain task or behaviour (Gencturk, Gokcek & Gunes, 2010, p. 2864; see also Knezek & Christensen, 2018), is a concept long studied in educational research. Operationally, it can be seen as self-perception of competence (Christensen & Knezek, 2017) in teaching with technologies, as research demonstrated that teachers who are competent need to also be self-assured on their competence, in order to perform well (Knezek & Christensen, 2018).

It is particularly interesting when observing and/or addressing teacher knowledge and practices, as researches showed that operating on technology knowledge alone is not enough to foster effective technology integration: teachers need to feel confident using that knowledge to facilitate students' learning (Abbitt, 2011; Banas & York, 2014; Ertmer, 2005; Ertmer & Ottenbreit-

Leftwich, 2010). Moreover, teachers are often found to avoid activities for which they lack confidence, engaging preferably in the ones in which they feel more prone to success (Pajares & Schunk, 2002). Technology self-efficacy related research sees it indeed positively related to teachers' feelings of accomplishment and commitment (Zee & Koomen, 2016), along with technology usage (Albion, 2001; Cassidy & Eachus, 2002), and technological abilities (Anderson & Maninger, 2007). Overall, self-efficacy seems to be a strong predictor of both intentions and actual technology integrations (Abbitt, 2011; Voogt et al., 2012), and their success (Koh & Frick, 2009).

Several are the instruments used in international research to investigate teachers' ICT integration self-efficacy. Wang, Ertmer and Newby (2004) proposed the *Computer Technology Integration Survey* (CTIS) with which they studied the influence of vicarious experiences and goal-setting tasks in pre-service teachers' self-efficacy belief development. Other surveys are Milman and Molebash's (2008), *Confidence in Personal and Instructional Use of Technology*, the *Technology Proficiency* self-assessment measure (in its most recent version of TPSA C1 - Christensen and Knezek, 2017), or Niederhauser and Perkmen's (2008) *Intrapersonal Technology Integration Scale*, developed to measure intrapersonal variables that impact on educators' ICT integration dispositions (see also Christensen & Knezek, 2018). This last one showed that expectations on the outcomes relate with self-efficacy, and both predict actual behaviour (Perkman & Pamuk, 2011).

Regarding the relation between self-efficacy and TPCK, it seems that several TPCK knowledge domains have a significant and positive correlation with technology-integration self-efficacy (Abbitt, 2011; Banas & York, 2014; Koh & Chai, 2014; Lee & Tsai, 2010). Abbitt (2011) studied TPACK and self-efficacy beliefs toward technology integration for 45 preservice teachers and found that TPK, TCK and TPCK especially may support higher self-efficacy beliefs about technology integration. Joo (et al., 2018) researched 296 preservice teachers on the structural relationship between self-efficacy, TPACK, and perceived ease of use and usefulness, based on *Technology Acceptance Model* (TAM). They found that preservice teachers' TPCK significantly affect their self-efficacy and perceived ease of technology use, which in turn impacted greatly teachers' intention to use technology (see also Banas & York, 2014; Ottenbreit-Leftwich et al., 2018). TPCK in itself had a strong influence on self-efficacy (as in Abbitt, 2011; Semiz & Ince, 2012), but only through that, perceived ease of use and usefulness of technology, it could actually impact on teachers' intention to use technology. Perceived technology usefulness, in particular, was crucial: however confident and comfortable with using technology, participants would not accept it as a teaching tool if they did not feel it contributing to meaningful learning experiences (Joo et al., 2018).

On the teacher education side, measures of ICT self-efficacy are found to have a strong relation with learner-centred ICT uses (Chen, 2010; Ottenbreit-Leftwich et al., 2018), although mediated by pedagogical beliefs on ICT-enhanced teaching and learning. Studies found that completing ICT courses has a positive influence on preservice teachers' ICT self-efficacy (Albion, 2001; Lee & Lee, 2014), but the highest impact is given by authentic learning experiences (Banas & York, 2014) like design tasks (Ottenbreit-Leftwich et al., 2018). Ertmer and Ottenbreit-Leftwich (2010) point out how teachers' self- efficacy improves when they witness technology uses that truly foster students' success. They also offer some suggestions to build technology self-efficacy in pre-service teachers:

> (a) giving teachers time to play with technology; (b) focusing new uses on teachers' immediate needs; (c) starting with small successful experiences; (d) working with knowledgeable peers; (e) providing access to suitable models; (f) participating in a professional learning community; and (g) situating professional development programs within the context of teachers' ongoing work (Ertmer & Ottenbreit-Leftwich, 2010, pp.261-262).

Finally, Forkosh-Baruch (2018) reports on the importance to provide (pre-service) teachers with a stable infrastructure where they can access easily technology, offering tools that are content-based and tailored to learners' characteristics.

2.3 Attitudes

Attitude, seen as the individual's affective evaluation of a behaviour, based upon a set of beliefs (Fishbein & Ajzen, 1975), can be observed also in the perceived value of ICT in teaching and learning (Knezek & Christensen, 2018; Ottenbreit-Leftwich et al., 2018; Sang et al., 2010; Yagci, 2016). Being it referred to also as *value belief* (Ottenbreit-Leftwich et al, 2010), *perceived usefulness* (Teo, 2009) or even *subject*(*ive*) *norm belief* (Hazzan, 2003), some authors consider attitude a function of the strength of individuals beliefs about technology, and the evaluation of those beliefs (Niederhauser & Lindstrom, 2018). Attitude is a strong predictor of individuals intention to engage in ICT integration, as the more positive the attitude and subject(ive) norm, the stronger the intention to perform that behaviour (Ajzen 2012; Niederhauser & Lindstrom, 2018; Yusop, 2015).

Teachers who have positive attitudes toward ICT and perceive it to be useful in promoting learning will likely integrate ICT in their classroom more easily. Many researchers found a correlation between positive attitudes towards ICT, and actual integration in teaching practices (Lee & Tsai, 2010; Papanastasiou & Angeli, 2008). Teachers attitudes are found to play an important role in the effectiveness of technology use (Buabeng-Andoh, 2012; Sang et al., 2010), affecting measures of self-efficacy, personal use and adoption in teaching practice. On the other hand, studies like Hart and Laher's (2015) found the perception of technology usefulness to be the stronger predictor of attitudes.

As will be described shortly, attitudes have been widely studied in research and several inner components emerged, e.g. computer enjoyment, perceived usefulness, concerns, comfort, and anxiety (Christensen & Knezek, 2018, 2009; Niederhauser & Lindstrom, 2018). This last construct figures as particularly relevant in influencing technology integration behaviours (Agyei & Voogt, 2011; Chiu & Churchill, 2016). Some researches found that high levels of anxiety about technology tend to develop negative attitudes toward it and resist its use (Pamuk & Peker, 2009). On the other hand, when teachers increase in feeling comfortable (i.e. less anxious) about technology integration, they are found likely to proceed among the stages of adoption of technology (Christensen & Knezek, 2001).

Being attitudes greatly helpful in defining the overall level of readiness for and proficiency in technology integration (Christensen & Knezek, 2018; Inan & Lowther, 2010a, 2010b), they have been studied with different instruments in the literature. Among the first ones is the *Teachers' Attitudes toward Computers* questionnaire (TAC), developed during 1995-1997 to study the effects of education for technology integration on teachers' attitudes (Christensen & Knezek, 2009). It comprised nine factor-validated constructs accounting for the different aspects of attitudes and it proved to be useful in preservice teacher education contexts. It was chosen to be the primary indicator of *will* in another broadly used instrument to measure teachers' attitudes toward technology integration: the *Will Skill Tool model of Technology Integration – WST* (Christensen & Knezek, 2009; Agyei & Voogt, 2011). This model showed how measures of *will, skill* and access (*tool*) can explain up to 90% of technology integration level (Christensen & Knezek, 2009), predicting integration as a function of attitude, competence and access to technology (Agyei & Voogt, 2011). In the WST model, *will* is seen as the result of affective, cognitive and conative components regarding teachers' acceptance of the usefulness of technology and actual technology integration (Agyei & Voogt, 2011). Authors show how computer anxiety and computer enjoyment, in particular, are the most important predictors of intentions towards computer use. The *skill* component, also viewable as a self-efficacy measure, is correlated with the individual's decision to participate in computer-related activities as technology-competent (Agyei & Voogt, 2011) by using the computer like a tool for authentic student-engagement in learning. Skills are said to influence teachers' expectations and emotional reactions regarding effective use of modern technology (Agyei & Voogt, 2011; Farjon et al., 2019), and researches see in them strong predictors of classroom integration of computer use (Knezek & Christensen, 2008). Finally, *access* is found to affect attitudes and competencies in technology integration (Agyei & Voogt, 2011; Christensen & Knezek, 2009). Recently, the WST was revised in the already mentioned *Will Skill Tool Pedagogy (WSTP* – Knezek & Christensen, 2016) as the authors tried to push prediction rates of technology integration over 90% by observing any teaching style shown when integrating technology (*pedagogy* factor).

Other instruments used in researching attitudes for technology integration are, for example, the *Computer Attitude Scale* (*CAS*) and its revision *ICT-AST* (Leng, 2011). This comprises factors like *confidence in computer usage, anxiety* and *computer liking*. Researches using this instrument found a strong relationship between attitudes and access to technology (Christensen & Knezek, 2018; Leng, 2011).

On the teacher education side, promoting positive attitudes towards ICT is sometimes addressed as end goal on its own (Knezek & Christensen, 2018) and the educational context is found to be powerfully influential in pursuing it (Blackwell, Lauricella & Wartella, 2014; Teo, 2009). Some studies suggest once again for educational programs to incorporate real-life experiences (Drent & Meelissen, 2008), or create communities supporting positive attitudes towards ICT educational uses (Chiu & Churchill, 2016; Ottenbreit-Leftwich et al., 2018). With regards to operating on anxiety decrease, several studies suggest increasing (student) teachers experiences with technologies (Agyei & Voogt, 2011; Christensen & Knezek, 2001; Gurcan-Namlu & Ceyhan, 2003). For (student) teachers, to practice and familiarize with new technology until they feel comfortable around them and perceive their professional usefulness, is important (Koh & Divaharan, 2011). Education can indeed help teachers feel less anxious and value more technology integration (Christensen, 2002; Christensen & Knezek, 2008; Lambert, Gong & Cuper, 2008), especially through hands-on tasks (Angeli & Valanides, 2009; Niess, 2005) and group works (Angeli & Valanides, 2009; Tondeur et al., 2019, 2016).

2.4 Dispositions and Teacher Knowledge (TPCK)

Technology integration in teaching is shaped by teachers' professional knowledge (see the TPCK framework - §Chp.1), and this is both moulding and being predicted by individual dispositions, together informing manifest technology integration behaviours (Niederhauser & Lindstrom, 2018; Ottenbreit-Leftwich et al., 2018). For those to be meaningful, technical skill acquisition is necessary, but it needs to be supported by strong pedagogical beliefs and self-efficacy, as well as positive attitudes towards ICT integration.

The literature highlights difficulties in determining how single dispositions independently influence teachers' ICT uses: Ottenbreit-Leftwich and colleagues (et al., 2018) report that when ICT is examined in general, computer knowledge is more strongly associated with technology use than attitudes and beliefs (see also Inan & Lowther, 2010a; Karaca et al., 2013; van Braak, Tondeur & Valcke, 2004). Tondeur and colleagues (Tondeur, Valcke & van Braak, 2008) suggest that knowledge and dispositions' influence on ICT actual integration are likely to differ depending on the ICT practice assessed. Such remark accounts for the personal and context-sensitive relation between dispositions and ICT uses, which changes over time (Levin & Wadmany, 2008) and/or could be reported biased due to socially desired answers (Desimone, 2009; Kopcha & Sullivan, 2007).

Furthermore, although teachers' knowledge and dispositions may be effective enablers and predictors of technology integration, they often miss explaining why or how technology uses differ (Hall, 2010; Niederhauser & Lindstrom, 2018), e.g. when a mismatch between them is observed. Ottenbreit-Leftwich and colleagues (et al., 2018) report on how most of the current research focuses on predictive models that do not investigate the characteristics of the relation among TPCK, dispositions and actual teaching practices with technologies (Christensen & Knezek, 2008; Inan & Lowther, 2010a, b). The construct of teacher's pedagogical reasoning that will be introduced in the next chapter (§Chp.3) tries indeed to explain the nature of this relationship.

CHAPTER 3.

TEACHERS REASONING PROCESS FOR TECHNOLOGY INTEGRATION

Introduction

Technology integration in teaching practices is influenced by several internal and external factors (Ertmer, 1999; Christensen & Knezek, 2018; Ottenbreit-Leftwich et al.,2018). For example, teachers may feel external pressure to use technologies to follow trends or please stakeholders, or be motivated by personal desires to be innovative (Dennen, Burner & Cates, 2018; Tondeur et al., 2012). As perceivable, teachers' decisional processes are complex and cannot be separated by professional knowledge (in this dissertation – TPCK) nor dispositions, all three being intimately intertwined and mutually shaped. In the previous chapters, teachers' professional knowledge base (§Chp.1) and dispositions (§Chp.2) related to effective technology integration were addressed. This chapter will go more in detail within teachers' decisional process to integrate technology in their practices, through the concept of pedagogical reasoning.

First, the observable modalities of technology adoption, in consideration of the different learning theories and conceptions of affordances underpinned (§Chp.3.1). When investigating practices of technology integration, studies report how teachers move from the identification and proper use of the allegedly most appropriate technological tools to support specific curricular goals and learning experiences (Ertmer & Ottenbreit-Leftwich, 2010); from the concern about how to attend and support each aspect of the learning process through the use of those technological means (Niess & Gillow-Wiles, 2013); or from the implementation of peculiar affordances to address needs and issues related to the teaching-learning practices (Ertmer & Ottenbreit-Leftwich, 2010; Herring, Koehler & Mishra, 2016). Some scholars specifically link teachers' process of choosing and using technologies to (a) technical skills for technology uses related to specific curriculum domains; (b) awareness of technologies' affordances in light of pedagogical and/or domain specific goals; and (c) ability to employ technology in pedagogically sound ways aimed at achieving specific content goals (Voogt et al., 2016).

The way teachers cope with technology-enhanced teaching and learning practices depends on how they specifically reason about their profession (Voogt et al., 2016; Voogt & McKenney, 2017). For a meaningful technology integration, it is important that teachers' professional reasoning and actions match (Britten & Cassady, 2005), but while it is possible to analyze actions, reasoning processes are more difficult to identify. Although there is no unified model to understand teachers' reasoning for adopting technologies in their practices (Niederhauser & Lindstrom, 2018), here a review on the most accredited ones will be presented (§Chp.3.2). Research evidence related to the different models for teachers' reasoning about ICT integration will be also presented, always considering the inevitable links among reasoning, dispositions and TPCK (§Chp.3.3).

As will be discussed, it is important that teachers' reasoning lays on solid foundations, in order to resist external (non-educational based) pressure, and to realize meaningful technology-enhanced teaching. For this reason, and in line with the objectives of the present dissertation (§B-Chp.1), this chapter (§Chp.3.2.2) reports also on some theoretical strategies and empirical researches to develop pedagogical reasoning for technology integration in pre-service teachers.

3.1 Pedagogically sound forms of ICT integration

3.1.1 ICT Integration Theories and Models

Niederhauser and Lindstrom (2018) describe three theoretical approaches to model how and why teachers integrate ICT in their practices. Two have been already mentioned in the Chapter about dispositions (§Chp.2) as they deal mainly with intrapersonal factors, namely the *Theory of Planned Behaviour* and the *Social Cognitive Theory* (Ajzen 2012; Bandura 1986). The third one is the *Diffusion of Innovations theory* (DOI – Rogers, 2003), which observes how innovations spread out within a society. It defines adoption stages for the users (i.e. laggards, late majority, early majority, early adopters, and innovators – Rogers, 2003) as well as individual developmental stages in the innovation-decision process (i.e. knowledge, persuasion, decision, implementation, confirmation). While it can help understanding how innovations circulate within a society, DOI alone cannot account effectively for the causes that spark the adoption process in teachers specifically (Niederhauser & Lindstrom, 2018).

On this topic two models dealing with teachers' intentions to adopt technologies pose as particularly interesting: the *Concerns-Based Adoption model* (CBAM – Hall, 1974) and the *Unified Theory of Acceptance and Use of Technology* (UTAUT – Venkatesh, Thong & Xu 2012). The first one considers teachers' concerns in the process of technology adoption, related to their level of technology use. *CBAM Stages of Concern* dimension proposes a predictable progression in teachers' concerns about technology innovations in seven developmental stages: unconcerned, informational, personal, management, consequence, collaboration, and refocusing (Christensen & Knezek, 2018). Its *Levels of Use* (LoU) dimension observes how increase in familiarity and skilfulness with a technology can relate to a change in teaching activities, presenting eight phases: non-use, orientation, preparation, mechanical use, routine use, refinement, integration and renewal (Hall, Dirksen & George, 2006). CBAM model resulted in an operative instrument to describe innovators' behaviours: *CBAM LoU*, found "time-efficient […] as indicator of an educator's progress along a technology utilization continuum" (Christensen & Knezek, 2018, p. 366). Nevertheless, scholars like Straub (2009) point out how the whole perspective here moves from an assumption of teachers' resistance to change and innovation, which could give an unrealistic, biased picture of teachers' approach to technology adoption.

The *Unified Theory of Acceptance and Use of Technology* (UTAUT) wants to identify teachers' intentions to use a specific information technology, comprising three constructs: performance expectancy, effort expectancy and social influence (Venkatesh et al., 2012). Still figuring as an important model, UTAUT's limitations lay in not considering variables like affective factors, experiences or external support (Niederhauser & Lindstrom, 2018).

When observing the ways technology is indeed adopted to enhance and transform educational practices it is to highlight, among the others, Taylor's (1980) classification of approaches to computer supported learning. Here, technology figures as a tutor, a tool or a tutee (see also Bottino, 2004). More recently, Britten and Cassady (2005) proposed a continuum to describe the extent to which educational practices depend on technology application, namely non-essential, supportive and essential (see also related research by Heitink et al., 2016). On the same line there is *Substitution, Augmentation, Modification and Redefinition* (SAMR – Puentedura, 2012), which offers a scale for investigating how teachers' use of technology enhances instructional practices (Niederhauser & Lindstrom, 2018). Technology integration measures are also the *Apple Classrooms of Tomorrow* (ACOT) survey and the *Stages of Adoption of Technology* (Christensen, 2002). ACOT identifies five developmental stages in teachers' progresses in technology integration: entry, adoption, adaptation, appropriation, and invention (Christensen & Knezek, 2018). *Stages of Adoption of Technology* proposes instead six stages for a teacher to self-assess their level: awareness, learning the process, understanding and application of the process, familiarity and confidence, adaptation to other contexts, creative application to new contexts (Christensen, 2002).

Within the specifics of the educational context, it is safe to assume that however technology is adopted and implemented, it should be aimed to enhance learning through its peculiar strengths and potentialities (Jonassen, Peck & Wilson, 2000). For this reason, another important construct to keep in mind is one of technology's affordance, which will be addressed in the next paragraph.

3.1.2 ICT Integration and Technological Affordances for Teaching and Learning

Teachers' decision to integrate technology lays on the type of relationship they have with it (Ihde, 1993), based on their skills, self-confidence and beliefs, but also on the uses they see for technology. As Kiran and Verbeek (2010) describe, people do not just surrender themselves to technology, but make their intentions interact with the ones of technology, explicated in the affordances (Voogt et al., 2016). The term goes way back, with definitions like Pea's (1993) who identifies affordances in perceived and real properties of the objects, functional characteristics that guide the object's usage; or Gibson's (1999) one, highlighting that affordances do not change according to the observer's needs, but are invariant and always ready to be perceived (Messina & De Rossi, 2015).

Several technologies available today were not originally built for teaching, but some of their affordances could be adapted to enhance the learning process of specific contents in specific pedagogic contexts (Koehler et al., 2011; Smits, Voogt & Van Velze, 2019). McGrenere and Ho (2000) claimed two different types of technologies' affordances: objectives (independent on value, interpretation or meaning to the users), and subjective (dependent on the user, who may even never realize them all – see Hutchby, 2001). More recently, Wang (2009) distinguished three types of affordances: pedagogical ones (in the object's characteristics that determine if and how its use can implement a specific learning activity); social affordances (real and perceived properties of an instrument that can foster social interaction among the users); and technological affordances (as usability, in the ways an instrument allows to realize a certain group of tasks in an efficient and effective way, satisfying for the users – see also Messina & De Rossi, 2015). Angeli and Valanides (2018) move from these works to talk about technical and pedagogical affordances. The first ones are deemed invariant, realized by the technology-designers, while pedagogical affordances are subjectively perceived and differently emergent in relation to the educational context and use. Thus, pedagogical affordances can be considered those context-sensitive affordances for technologies for teaching and learning perceived by educators. Teachers' understanding and realization of these pedagogical affordances require a demanding cognitive process, which Haines (2015) states directly related to instructional design tasks, where teachers use technologies moving from their content knowledge, work practices and contexts (Angeli & Valanides, 2018).

In research, there are various attempts to classify technologies' affordances in instructional design contexts (Angeli & Valanides, 2013, 2018; Messina & De Rossi, 2015; see also §Chp.1.2.3). Conole and Dyke (2004) proposed a general taxonomy of ICT affordances including diversity, communication, reflection, multimodality, accessibility and speed of change. Hunter (2015) modelled 22 *pedagogical fit* of technologies, from observations and interviews of exemplary technology-integrator teachers. Starkey (2011) offers a tool to observe how technologies' affordances are realized in pedagogical practices, identifying six technology-enhanced learning aspects: act within a context (e.g. find information online); make connections (e.g. share opinions on a platform); demonstrate conceptual knowledge; critique and evaluate information, sources and processes (procedural knowledge); create knowledge; and enable authentic emerging knowledge (Starkey, 2011). Finally, Harris and Hofer (2011) proposed a taxonomy that matches learning activities with specific technological affordances (see §Chp.1.2).

Considering teachers' difficulties in moving from technical affordances to the ones aimed to enhance learning (Ioannou, 2016), Angeli and Valanides (2018) propose a theoretical model to help explain and shape teachers' actions to turn technical affordances into pedagogical instruments. As the authors report, teachers need to be supported in their process to think creatively "about how the technical affordances of tools can be thought of as pedagogical affordances to bring about educational goals and objectives in classroom teaching and learning" (Angeli & Valanides, 2018, p. 404) Angeli and colleagues' model consist of five steps: (1) display of the *existence software's technical functions*, as intended by software designers and developers, with the aim of familiarizing teachers with them; (2) *technical affordances perception* deals with recognizing technical affordances' existence and performative potential; (3) *pedagogical affordances perception* where teachers start to think of technical affordances as enablers of pedagogical actions; (4) *pedagogical affordances actualization* in which teachers actually use perceived pedagogical affordances in their practices, reconsidering and refining these ones in light of their performance; and (5) *pedagogical affordances effect on learning* as a result of the actualization and reconceptualization of pedagogical affordances (Angeli & Valanides, 2018).

Various studies agree that the relationship between teachers and technology's affordances is not straightforward, as the latter ones change depending on the specific teaching practice (Kiran & Verbeek, 2010; Webb & Cox, 2004), realizing uses that go beyond the initial intentions for which they were designed (Voogt et al., 2016). Yet, as supported by theories like *technological mediation, social agency*, and others already mentioned (§Chp.1.1), different uses of technology may direct how people experience and interpret reality (Gell, 1998; Ihde, 1993; Voogt et al., 2016). Thus, it is essential for teachers to be aware of technology's technical affordances and be open to realizing pedagogical ones (Angeli & Valanides, 2018), as enacting them could expand teaching and learning possibilities greatly (Bower, 2008; Harris & Phillips, 2018). Researches on the topic agree that it is not yet fully understood how teachers perceive and actualize technologies' affordances, or how these are considered within the instructional design process (Angeli & Valanides, 2018), but working on this topic could have important consequences on improving pre-/in-service teachers' education programs (Haines, 2015).

Investigating and operating on the connection between ICT perceived affordances and teachers' pedagogical reasoning process during lesson planning seems a particularly effective strategy to enhance both theoretical understanding and teachers' education practices (Feng & Hew, 2005; Harris & Phillips, 2018; Smart, 2016; Webb & Cox. 2004). The reader will find more on this shortly (§Chp.3.2).

3.1.3 ICT Integration and Learning Theories

Affordances are also recognized and enacted in light of what teachers consider useful and aligned with their idea of teaching and learning, as ICTs are not theory-neutral technologies (Dennen et al., 2018; Voogt et al., 2016). This is reflected for example in the debate on digital natives (Prensky, 2005) which sees alternatively scholars asking for ICT integration in light of an "evident" shift in learning processes in the digital era, and others that challenge the whole concept of digital natives, arguing that education does not need to change significantly just in reaction to the learners' increased ICT awareness (see Bennet, Maton & Kervin, 2008; Krischner, 2017).

This paragraph will briefly report on three broadly acknowledged learning theories (Behaviourism, Cognitivism, Constructivism) and hint to a recently emerging one (Connectivism) in relation to technologies integration in teaching and learning (see Table 3.1).

Table 3.1 Learning theories and technology integration.

LEARNING THEORY	EPISTEMOLOGICAL AND PEDAGOGICAL CHARACTERISTICS	TECHNOLOGICAL AFFORDANCES	TECHNOLOGICAL PEDAGOGICAL STRATEGIES
Behaviourism (see, e.g., Skinner, 1958)	Reality is objectively known and taught. Learning is proven by consistent display of new behaviour. It can be strengthened or weakened by stimuli. Teachers have the main role in determining overall learning pace.	Incremental feedback Self-evident performance assessment Continuous users' information storage	Computer-assisted instruction (CAI) Programmed instruction Student Response System Individual formative learning assessment (e.g. points for participation) Self-paced mastery learning Drill-and-practice interactions Classroom management tools: digital record, reward and share of student behaviour.
Cognitivism (see, e.g., Ausubel, 1978)	Reality is objectively known and taught. Focus on internal cognitive processes. Learning involves information encoding, retrieval and processing in the interplay of work, short-term and long-term memories. Teachers are cognitive scientists.	Graphics functioning as advance organizers Chunks of information Sensory modalities of use dealing with cognitive load encoding	Conceptual learning through the use of digital schema or maps Multimodal and multimedia-based explanation of the content to reduce cognitive load e-learning for computer-based dissemination of information
Constructivism (see, e.g., Vygotsky, 1978)	Reality is subjectively perceived and given meaning to. Learning involves giving meaning to sensory-based experiences through human-based ones, with a ▪ Social/interactive locus of knowledge (social constructivism) ▪ Individual/internal locus of knowledge (cognitive constructivism)	Metacognition prompts Digital spaces for communication Scaffolded activity patterns	Computer supported collaborative learning Cognitive apprenticeship focused on co-construction of meaning Long distance modelling/mentoring e-learning for interaction-based activities
Connectivism (see, e.g., Siemens, 2005)	Reality is explored in networks that are continually changing thanks to technology. Learning is a process of connecting information (non)-human sources and experiences to enact within the learner's real/digital network. No clear role for the teacher, beyond being a network member.	Open source/collaborative writing Real time communication Portability of devices	Massive Open Online Courses (MOOCs) Bring Your Own Device (BYOD) for informal learning Virtual Classroom e-learning for interaction-based activities

Behaviourism theory deems reality objectively knowledgeable and teachable, posing as technology determinist in the assumption that "technology, along with its precisely designed learning materials, [is] the key to the promoting efficient instruction" (Dennen et al., 2018, p. 147). In this perspective, knowledge and skills are transferred as learned behaviours (Dede, 2008) and the main type of motivation to learning is extrinsic. The main technologies' affordances identified are usually the ones supporting an incremental learning, maybe to the purpose of monitoring attendance to courses, and can be observed even in game-like contexts to engage the learners while programming their instruction (Crompton et al., 2017; Dennen et al., 2018; Kebritchi & Hirumi, 2008). Even if this perspective is still widely used today, some researchers argue it might lead to oversimplified learning interactions (McDonald et al., 2005) and not acknowledge enough learning factors like attitudes or motivation (Dede, 2008; Dennen et al., 2018).

Cognitivism shares with Behaviourism the faith in an objectively knowledgeable reality, but focuses on the internal brain processes to learn about it: pupils are thought to learn through “mastering building blocks of knowledge based on pre-existing relationships among content and skills” (Dede, 2008, p. 48). For this reason, cognitivist teachers would organize and sequence information blocks to support optimal coding and retrieving among the three memories (i.e. work, short term and long term ones). The main motivation to learning sought is made up of a mix of intrinsic and extrinsic factors such as satisfaction from achievement, challenge and curiosity (Dede, 2008; Pintrich & Schunk, 2001). Affordances pursued by this theory are the ones that help to structure or modify mental maps of contents (e.g. graphic organizers), linking prior and new knowledge (Ausubel, 1978); and those which provide elaborate feedback to break misconceptions and explain responses (Dennen et al., 2018). Particularly interesting seems the *Theory of multimedia learning* (Mayer, 2009) which provides guidance for designing multimedia-based ICT aimed at reducing cognitive load, for example by matching multiple sensory modalities through ICT use, and support effective information encoding (Dede, 2008; Dennen et al., 2018). Other examples of cognitivism-based technology uses are intelligent tutoring systems (Dede, 2008) in which task types are selected in alignment to pupils’ past performance while feedback is used to monitor pupils’ evolving ones and model assessment (Dede, 2008).

Constructivism poses that reality is given meaning to by individuals, according to their experiences and reflections, which could take place within the person (cognitive constructivism) or in the social interaction (social constructivism). Educational practices enhance learning by fostering “rich, loosely structured experiences and guidance that encourage meaning-making without imposing a fixed set of knowledge and skills” (Dede, 2008, p. 51). Student motivation sought deals with challenge, curiosity, social recognition (Pintrich & Schunk, 2001). Preferred affordances encompass supporting metacognition and critic reflection on experiences, scaffolding autonomous performance. In teaching practice, this would translate in co-construction of meanings on collaborative platforms, or cognitive apprenticeships and modelling activities, even online based (Dennen et al., 2018). Other implementations could be simulations focused on complex skills that enable pupils to test their hypothesis and develop personally expressive representation of knowledge (Dede, 2008).

Finally, *Connectivism* (Siemens, 2005; 2008) as a newly emerging learning theory, is not yet fully accepted at the same level of the other three (Dennen et al., 2018; Voogt et al., 2018), but is deemed at least complementary to them by even its most fierce critics (see Bell, 2011)[2]. Connectivism defines learning as an autonomous process enacted by the learners within their network of (human and non) resources. Knowledge is distributed within a networked environment which is technologically and socially enhanced (Strong & Hutchins, 2009), while decision-making acquires a central role as "choosing what to learn and the meaning of incoming information is seen through the lens of a shifting reality" (Siemens, 2006, p. 31). Connectivism wants to account for the flexible and ever-changing reality where learning takes place (whereas behaviourism is based on controllable and stable external conditions); for the rapid growth and mutation of available information in the digital era (whereas cognitivism relies on how clearly new and previous knowledge/information is defined and recalled); and deems essential pattern recognition and interpretation in meaning-making and in creating emergent, iterative knowledge (whereas constructivism relies on how previous individual experiences' meanings can be brought into current reality – Strong & Hutchins, 2009). Particularly sought affordances are the ones enabling open collaboration and portability of the learning context (Abhari, 2017; Mac Callum et al., 2017; Wang, Chen & Anderson, 2014), with educational practices shaped like virtual classrooms or *Bring Your Own Device* ones.

In everyday teaching practices, teachers may shift from one learning theory to another according to planned activities and emerging needs, but awareness of the implications of their ICT integration choices on their pupils' learning processes is desirable. The next paragraphs will delve more into teachers' decisional processes when it comes to integrating technology, through the concept of pedagogical reasoning.

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[2] In this dissertation, this learning theory is introduced as further theoretical note helpful to explain the underpinnings for some teacher reasoning models (e.g. Starkey, 2010 - §Chp.3.3).

3.2 Teachers' Pedagogical Reasoning for technology enhanced learning

3.2.1 Theoretical Models for Teachers' Decision Making Processes

It is important to understand how teachers give meaning to and use technologies in their practices, considering their motives and expectations as shaped by professional knowledge, learning theories' approaches and perceived technologies' affordances (Brown, 2009; Voogt et al., 2016; Webb & Cox, 2004). Heitink and colleagues (et al., 2016) emphasize that underlying teachers' practices there is a professional reasoning process, which is as much a part of teaching as its performance (Shulman, 1987), and not as simple as just thinking about teaching (Nilsson, 2009). The main theoretical models for teachers' pedagogical reasoning will now be described as from accredited publications, presented chronologically in Table 3.2.

Table 3.2 Theoretical models for teachers' reasoning processes.

Author(s)	Shulman (1987)	Webb (2002, 2010)	Starkey (2010)	Smart (2016)
Name of the model	Model of Pedagogical Reasoning and Action (MPR&A)	Model of Pedagogical Reasoning	Model of Pedagogical Reasoning and Action for the Digital Age	Technological pedagogical reasoning
Phases/ steps	Comprehension Transformation Instruction Evaluation Reflection New comprehension	Comprehension Transformation Instruction Evaluation Reflection	Comprehension Enabling connections Teaching and learning Reflection New comprehension	Knowledge base (TKB + TPCK) Comprehension Transformation Instruction Evaluation (Reflection and New comprehension as transversal processes)
Further research references applying this model	Graham (2011) James & Scharmann (2007) Nilsson (2009) Peterson & Treagust (1992, 1995, 1998) Richardson (2009)		Niess & Gillow-Wiles (2017)	Smart, Sim & Finger (2015)

Trying to unravel the usually implicit teachers' decisional processes is not something new to research, with examples to be found in the concepts of reflection in- and on- practice, proposed by Schön (1983) or the notion of a critically reflective practitioner by Brookfield (1995). Gudmundsdöttir, in 1988, even linked explicitly in her model pedagogical reasoning with the teachers' professional knowledge, thought in relation to content, pedagogy, and learner knowledge.

One of the most important models for pedagogical reasoning related to teacher knowledge was proposed by Shulman in 1987, in the attempt to "unpack the unseen aspects of practice" of teachers (Loughran, Keast & Cooper, 2016, p. 368). When talking about the major sources for teachers' knowledge bases (see §Chp.1.1), within the realm of *wisdom of practice* Shulman described pedagogical reasoning as the cognitive process performed by teachers in order to teach. Although the different stages figured as a whole, dynamic process in which the shift from one part to another was not rigid, Shulman considered crucial for teachers to understand, recognize and work through each part of such cycle. He moved from the consideration that most teaching starts with some form of text, educational purposes and/or a set of ideas. From there, the ***Model of Pedagogical Reasoning and Action*** (MPR&A, see Table 3.2) comprised:

1. *Comprehension*, for "to teach is first to understand" (Shulman, 1987, p.14). Teachers need to deeply and critically understand the subject matter to be taught in its main ideas and structure, identifying errors or misrepresentations in the given text and/or personal knowledge (Shulman & Sykes, 1986). Furthermore, they have to balance the general goals of education (e.g. individual excellence, equality of opportunities, equity) with the specific context-related purposes of instruction (Shulman, 1987).

2. *Transformation* of the known content in forms that are both pedagogically powerful and adaptive to the specific pupils' differences in abilities and backgrounds (Shulman, 1987). Here, teachers would critically review materials choosing better and/or alternative content representations like analogies, metaphors, examples, demonstrations, simulations (Shulman, 1987). To effectively use personal comprehension as a base for preparing the comprehension of others, a teacher would go through a combination or ordering of:
   - □ *Preparation* and critical interpretation of the given text, recognizing flaws in the representation of ideas and determining how to fix them, even with the ingeneration of alternative pedagogical representations of the key ideas (Shulman, 1986, p. 16);
   - □ *Representation* of ideas in new forms, better adapted to students' characteristics. Shulman encourages at this point multiple forms of representation to provide better learning conditions (Shulman, 1987);
   - □ *Instructional selection* of strategies, including teaching methods and models from their instruction repertoire (e.g. lecture, demonstration, reciprocal teaching, Socratic dialogue, discovery learning and so forth – Shulman, 1987);
   - □ *Adaptation* of representations to better fit the characteristics of the pupils, considering their abilities, "gender, language, culture, motivations, prior knowledge and skills that will affect their responses to different forms of representation" (Shulman, 1987, p. 17);

- *Tailoring* the adaptations to the specific group attending the class. It includes fitting representations to a specific group of students of a particular size, disposition, receptivity and interpersonal chemistry (Shulman, 1987);

These transformation processes together, says Shulman (1987), will result in a plan or set of strategies to present a unit, lesson, or course.

3. *Instruction*, as observable acts of teaching (Harris & Phillips, 2018), involving classroom organization and management; presentation of clear explanations and descriptions; assignment and check of work; and effective interaction with students through probes, answers, reactions, praises and criticism.
4. *Evaluation*, in the form of checking students' understanding, assessing their learning and evaluating/adjusting the teacher's own performance. It involves a deep grasp of both the content material and the processes of learning (Shulman, 1987).

5. *Reflection*, as review, reconstruction and analysis one's own and students' performance (Loughran et al., 2016). It entails the reconstruction, re-enactment, and/or capture of events, emotions and accomplishments of the teacher (Shulman, 1987), always in relation to the sought goals. It has the aim of personal improvement through learning from experience and it covers all the above mentioned steps.
6. *New comprehension* of educational purposes, students, content and teaching practice itself. It takes the form of a new understanding, based ideally on forms of documentation, analysis and discussion, and it leads back into *comprehension* to enable the whole reasoning process to begin again (Smart, 2016).

In Shulman's view, while the different elements may be singularly truncated or widened, it is crucial for a teacher can prove the capability to engage in these processes and "teacher education should provide students with the understandings and performance abilities they will need to reason their ways through and to enact a complete act of pedagogy" (Loughran et al., 2016, p. 19).

While this model is still considered highly relevant when talking about teachers' pedagogical reasoning, some critics arose along the years. First of all, and as acknowledged by Shulman himself (2015), there are some inconsistencies in his different publications (Smart, 2016) when defining the overall steps, which move from 7 in 1986 (i.e., comprehension, preparation, transformation, adaptation, presentation, evaluation and reflection - Shulman & Skyes, 1986), to 6 steps in two publications dated 1987 (i.e. comprehension, transformation, instruction, evaluation, reflection and new comprehension – Shulman, 1987; Wilson, Shulman and Richers, 1987), but with a different internal description of *transformation*. Moreover, in *evaluation*, Shulman said a teacher would assess their own performance through reflection, and that *evaluation*, along with *new comprehension*, are the bases for teacher on-the-spot adjustments during class work. This may lead to some confusion regarding the boundaries among *instruction*, *evaluation*, *reflection* and *new comprehension* (Smart, 2016). Some researchers even suggest that *reflection* and *new comprehension* are fundamentally the same (Smart, Sim & Finger, 2015), as "each element of reflection would be a new understanding different from what they knew before the lesson and if they are recalling it then there is something that happened to trigger that recall" (p. 3424). Others would understand *new comprehension* not as a separate logical phase within the cycle, but a relationship between *reflection* and other processes (Webb, 2002). Others still would see *new comprehension* as influencing *comprehension* but being influenced by *transformation, instruction* and *evaluation* (concept of *teaching concerns* – see Nilsson, 2009).

Empirical researches dealing with MPR&A generally report a *loose* (Richardson, 2009) but consistent realization of the steps in (student) teachers' instructional planning processes across different disciplines (see Meredith, 1995; Peterson & Treagust, 1995; Richardson, 2009; Smart et al., 2015). One example among the others, James and Scharmann's (2007) study reports how pre-service science teachers greatly benefited from the use of analogies in teaching science concepts.

As the reader might recall from §Chp.1.1, Shulman's idea of teacher knowledge as PCK was widened in more recent years to include also technology knowledge, thus becoming TPCK (Koehler & Mishra, 2005b). Harris and Phillips (2018) reflect on this, questioning whether MPR&A is still relevant when discussing teacher pedagogical reasoning about technology-enhanced instruction. They argue that:

> if the use of transparent technologies can be considered to be part of the knowledge base for teaching, and if PR&A is the process by which teachers use tools (in part) to assist their students' learning, then the introduction of *transparent* technologies into a teacher's repertoire should not require *technological pedagogical reasoning and action* (TPR&A) (Harris & Phillips, 2018, p. 2056).

While they acknowledge that *instruction* and *evaluation* steps change when technologies are involved, according to affordances, they question if the other reasoning steps get really modified too. They come to the conclusion that PR&A would become TPR&A "only when teachers' reasoning and/or action are technocentric" (Harris & Phillips, 2018, p. 2058), agreeing with Graham (2011) who saw the knowledge needed to integrate transparent technology uses as part of original's Shulman model.

On the other hand, many studies account for significant differences between MPR&A and some kind of technological pedagogical reasoning (Nilsson, 2009; Smart, 2016: Smart et al., 2015; Starkey, 2010; Webb, 2002), so much so that advise for a new or amended model. For example, Smart (2016) suggests that in an era where teaching materials, curriculum documents and pedagogical approaches are easily found and shared on technological means, teachers' *comprehension* of materials needs to include also the use of technology to access and process them. Moreover, when teachers use classroom management systems to analyze/compare students' results, they would enact *reflection* as a personal affective review while *evaluation* would become a more analytical review of one's own performance (Smart et al., 2015).

Webb (Webb, 2002; Webb & Cox, 2004) describes a different model for pedagogical reasoning related to teaching with ICT, suggesting that learning and teaching are not as distinct in the digital age as they once were: learning takes the shades of self-direction and metacognition, while teaching is more collaborative. Webb (2002) revised Shulman's model including also non-rational elements which the author himself recognized as a limit of MPR&A (Shulman, 2015). In Webb's model are found knowledge, ideas, beliefs and values "that teachers use to prioritize and select from their knowledge base to justify their decisions" (Webb, 2002, p. 241). She highlights the importance of these non-rational components in influencing *transformation, instruction* and *evaluation* processes (Smart, 2016). Her description of ***Pedagogical Reasoning*** (see Table 3.2) is:

1. *Comprehension* of the main ideas to be taught, in consideration of education purposes and previous content-related teaching experiences;
2. *Transformation,* as in Shulman's sub-categorized in: *preparation*, *representation*, *instructional selection*, *adaptation* and *tailoring*. Differently from Shulman, though, Webb deems teachers' beliefs, ideas and values as factors influencing each and every stage of transformation;
3. *Instruction* with consideration of the specific ICT affordances;
4. *Evaluation* in which the teacher needs to activate his/her PCK to predict issues and be ready for questions to enable students' learning with ICT; and
5. *Reflection.*

In her model, *new comprehension* is considered as a data flow from *reflection* to *comprehension*, although no further explanation is provided (Smart, 2016). In later years, Webb (2010) refined this model to include the learners and their learning processes as integral part of teachers' pedagogical reasoning with ICT. She suggests that teachers could ease learning by acknowledging, sharing and enacting the specific affordances provided by ICT with students.

Another scholar who tried to refine MPR&A for the digital age is Starkey (2010) with her ***Model for Pedagogical Reasoning and Action for the Digital Age*** (MPR&A-DA, see Table 3.2). She investigated the pedagogical choices of six beginning teachers through observation and think alouds, finding a general alignment between participants' pedagogical reasoning and Shulman's model (Starkey, 2010). However, a significant variation appeared on the teachers' chosen resources. The author found out that their instructional decisions were based on "learning theories predating the digital era and this was limiting their ability to use pedagogical content knowledge innovatively" (Starkey, 2010, p.243). Thus, she adopted the connectivist approach to learning in formulating a new model, which implies:

1. *Comprehension* of the subject matter, articulated in substantive and syntactic knowledge of the discipline;
2. *Enabling connections* (in accordance with Connectivism lexis) entailing
   - □ *Selecting* effective resources and methods to allow students to connect their previous and developing knowledge on the topic;
   - □ *Transforming* expert knowledge into teachable content;
   - □ *Enabling opportunities* for pupils to create, share and critique knowledge;
   - □ *Enabling connections* among groups and individuals to improve content knowledge development;
   - □ Adaptation and tailoring (*personalization*) of learning according to the specific group of pupils;
3. *Teaching and learning* including the knowledge of the context, formative and summative evaluation, feedback strategies and on-the-spot modifications of teaching practices when called for;
4. *Reflection* as critic review and analysis of teachers' decisions; and
5. *New comprehension* on students, teaching processes and the content.

Starkey highlights the idea of students building knowledge through "connections in an open and flexible curriculum" (Starkey, 2010, p. 243), whereas she attributes to Shulman a more transmissive idea of teaching, in which truths and methodologies of a subject are pre-determined by a fixed curriculum. She suggests that teachers "in a connectivist learning environment would transform existing knowledge as outlined in Shulman's model, but would also encourage students to go beyond the teacher's existing knowledge base by making or enabling connections" (Starkey, 2010, p.241). Different readings of Shulman's model, though, offer a more nuanced vision of the issue. Harris and Phillips (2018), for example, report that Shulman did not reject learner-centred approaches, being rooted in Constructivism himself, but he did assign to teachers the primary responsibility for planning, assessing, facilitating and tailoring students' learning.

In 2017, Niess and Gillow-Wiles used Starkey's MPR&A-DA for an in-depth study on masters' level mathematic teachers. They observed participants' reasoning through the use of a combination of multiple technologies in a system of learning with technologies (Niess & Gillow-Wiles, 2017). The authors hypothesized that in order to support teachers' TPCK, multiple technologies should be "holistically integrated to become more than a simple combination of technologies, resulting in a self-contained pedagogical tool in its own right" (Niess & Gillow-Wiles, 2017, p. 82). They found three themes emerging from participating teachers' portfolios and concerning their technological-pedagogically focused mental models: namely, cognitive, socio-cognitive, meta-cognitive and motivational functions (Niess & Gillow-Wiles, 2017). They also noticed a strong collective recognition of the importance of learner-centred instruction, with the teacher in position of facilitator or guide, posing the research on the verge between Constructivist and Connectivist approaches. Finally, they suggest that incorporating a systems pedagogical approach, especially in teacher education contexts, would involve: (a) integrating instructional strategies and technologies; (b) integrating multiple technologies through active student engagement; and (c) preferring learner-centred instruction approaches (Niess & Gillow-Wiles, 2017).

Recently, Smart (2016; Smart et al., 2015) researched teachers' pedagogical reasoning throughout different career stages, seeking to better conceptualize influencing factors to the reasoning development. She observed that in *comprehension*, teachers would be able to access a multiplicity of materials through technologies unseen in Shulman's times. They would start by re-defining their content to align curriculum guidelines and their students' interests, but consider also available technologies to better understand the "technological culture" of their educational context (Smart et al., 2015). During *transformation* the participants focused on "identifying the value of digital technologies to transform the content" (Smart, 2016, p.284), and they would carry out a "transform-during-teaching" action when checking for pupils' content (mis)understandings during *instruction*. Here, Smart reports how "digital technologies changed the dynamics of the classroom where participating teachers were able to focus on checking for student understanding individually instead of directing from the front of the room" (Smart, 2016, p. 288). Even *evaluation* was deeply influenced by technology, especially in terms of instruments used, while *reflection* was observed to happen during all the different stages, especially when participants "had to deviate […] changing their teaching from what they had planned" (Smart, 2016, p. 292). Once again, technologies stand out in this phase when teachers reported a significant difference in using digital technologies for teaching or for learning. Finally, in *new comprehension* Smart found teachers to share new understandings of content, students and pedagogy, as predicted by Shulman (1987), but she noticed a predominance of focus on the use of new digital technologies.

She thus revised Shulman's model proposing a ***Technological Pedagogical Reasoning Model*** (TPR, see Table 3.2), considering MPR&A issues on stages' blurred boundaries and the redefinition of curriculum material access thanks to technologies. Moreover, she reflected on evaluation-during-instruction processes that modify content transformation in answer to contextual emerging needs and technologies contingent effectiveness (e.g. troubleshoots or affordances). Along with *evaluation*, also *reflection* is deemed to be transversal to all the processes, thought as "a trigger that generates a change in the teacher's knowledge base, which then feeds back into how they comprehend, plan, teach and evaluate" (Smart, 2016, p. 301). In her TPR model, she considers the main steps of MPR&A (i.e. *comprehension, transformation, instruction, evaluation*), but poses *reflection* and *new comprehension* as transversal processes, adding a *knowledge base* modeled after Shulman's description (1987) with the addition of TPCK (Koehler & Mishra, 2008).

Smart and colleagues (et al., 2015) investigated teacher TPR and the factors influencing its development in Australian teachers. They engaged experienced in-service teachers, digital pedagogy leaders in their schools. They used the SMART *Classrooms Professional Development Framework* (SCPDF – Smart et al., 2015) which provided a self-assessment mechanism for teachers' attitudes and practices with ICT, and a *Digital Pedagogical License* (DPL) in form of portfolio. The authors found evidence of the different TPR processes, with particular reference to *new comprehension* related to ICT use (Smart et al., 2015).

Overall, it seems that Shulman's MPR&A (1987) still figures as crucial reference for many of the recent modelling of teachers' reasoning process with technology, where in alignment (see Webb, 2002), where in opposition (see Starkey, 2010). From the presented models it seems that reasoning as a system is not easy to break down in clearly delimited phases which, however unpractical from a theoretical perspective, may actually account for real-life occurrence of the phenomenon. Further research is needed to support the different models with empirical evidence, so to further clarify the inner components and dynamics of teachers' reasoning for technology enhanced learning.

3.2.2 Research on Teachers Pedagogical Reasoning Development

Along with researches on the theoretical definition of pedagogical reasoning models, there are others focused on detecting its practical manifestations and possible strategies for its development within teacher education. These usually agree on the difficulty of making teachers aware of their tacit reasoning processes (Heitink et al., 2016) and mostly use interviews, focus groups, think-aloud and video recall to promote its explication (see Smart, 2016).

For example, Heitink and colleagues (et al., 2016) analysed 157 video cases of Dutch teachers' practices and self-assessment (through a questionnaire) to detect the reasons why teachers may be interested in and actually perform technology integration. Along with a focus on professional reasoning, they included measures of dispositions, TPCK, and technological expertise and use. Observing video-recorded technology integration in practice, they came to the idea of *fit* as coherence in specific technological applications with strengthened pedagogy, content, both or neither, within the specific learning activity depicted (Heitink et al., 2016). What Heitink and colleagues found was a mismatch between teachers' reasoning and pedagogical uses of technology in their practices. They would focus on attractiveness (for pupils) and efficiency (for teachers, in terms of workload), with a few mentions of technology facilitating learning, enhancing interactions or skills, enrich the curriculum (Heitink et al., 2016). The authors concluded that there is the need to make (student) teachers "better able to articulate the reasoning behind the use of technology in their teaching, share this reasoning with colleagues" (Heitink et al., 2016, p.82). To this purpose, they identify a good means in authentic, practical examples of technology-enhanced teaching to reflect upon, and critically discuss.

In later research, these authors (Heitnik et al., 2017) tried helping teachers eliciting their reasoning about ICT integration, hypothesising a subsequent improvement in their technological pedagogical knowledge[3]. Their research involved the analysis of 29 video cases, showing that while teachers used ICT mainly at a low level of pedagogical strategies (e.g. promote activation of learning), their professional reasoning was interestingly more focused on higher pedagogical strategies levels (e.g. adaptive teaching), in findings similar to what already noticed by So and Kim (2009). Heitink and colleagues inferred that their participants saw ICT potentialities for higher order pedagogical strategies, but maybe were not yet comfortable in using technologies for those purposes. They argue that "for effective teaching with ICT it is important that teachers learn to

[3] The authors referred to the TPCK framework, but operated with Primary teachers, which are required to manage different subject matters. For this reason, they did not focus on content specifics (Heitnik et al., 2017).

reason explicitly about how ICT can support specific pedagogical strategies" (Heitink et al., 2017, p. 96).

Nilsson (2009) tried to make student-teachers' aware of their concerns through the use of critical incidents connected to classroom management, pupils' attitudes and learning. The 22 participating Swedish student-teachers were engaged in an educational course in which MPR&A was used as methodological framework to shape the analysis of such critical incidents. Participants were found to deeply question their practices and "gain new insights into teaching as being problematic" (Nilsson, 2009, p.239). The author argued that "by helping student teachers focus on critical incidents […] and linking those experience with concrete aspects of their own pedagogical reasoning, student teachers can direct their own professional development" (Nilsson, 2009, p. 255). In her view, student-teachers need to be helped in becoming aware that teaching is problematic and move past the expectations of learning to teach as being told how to do teaching (Nilsson, 2009). It is necessary to encourage student-teachers to analyse their own practices, understanding what, why and how they do what they do, so to make them more empowered to seek new conceptualizations of their practice.

Generally, studies show that when (student) teachers reflect within an MPR&A framework or similar, their overall pedagogical reasoning improves (see Smart, 2016). Further research is needed, though, to understand better how to best support (student) teachers' reasoning development within teacher education programmes.

3.3 Pedagogical Reasoning, Teacher Knowledge (TPCK) and Dispositions

Several empirical researches dealing with the different interpretations of teachers' pedagogical reasoning report the high influence of pedagogical beliefs on it (Peterson and Treagust, 1992,1998), and the deep links with the development and shaping process of teachers' knowledge base TPCK (Voogt et al., 2016).

Some researchers suggest that understanding teachers' reasoning about technological affordances in the teaching-learning process would enhance their TPCK understanding (Voogt et al., 2016), while others think that TPCK should be used to better understand the reasoning processes of teachers (Harris et al., 2017). In any case, several studies highlight teachers' need to be comfortable (yet another link with dispositions and self-efficacy) and acknowledgeable in technology use, in order to pedagogically reason (Smart et al., 2015). Even when digitally-able teachers can effectively integrate technology for knowledge creation, critique and sharing, they still need to critically understand teaching and learning theories in the digital age, and how these influence their dispositions to the whole process (Starkey, 2011).

Beliefs are found to have a large influence on pedagogical reasoning also by studies like Bryan and Tippins' (2006), Smart's (2016) and many others (see Knezek & Christensen, 2018; Voogt et al., 2012). As mentioned briefly in paragraph §3.2.1, even Shulman himself reflected on his original definition of knowledge base for teaching (and MPR&A in it) as not taking into enough consideration beliefs and non-rational factors (Shulman, 2015).

Finally, because teacher knowledge and dispositions are intertwined, both affecting the process of pedagogical reasoning, scholars like Voogt and colleagues (et al., 2013) recommend understanding the implications on the latter, when technology use comes to play in educational practice. In accordance with what reported by Harris and Phillips (2018), "we still have much to discover about how and why teachers' TPACK […] is applied and expanded within the processes that comprise teachers' PR&A" (Harris & Phillips, 2018, p. 2059).

Conclusions

In this chapter some of the most observed modalities of ICT integration in education were described (§Chp.3.1.1), in light of the technologies' perceived affordances and underpinning learning theories (§Chp.3.1.2-3.1.3). Then, theoretical models to explain teachers' reasoning processes to integrate technologies were discussed (§Chp.3.2), finding an important base in Shulman's MPR&A (1987).

Along with different conceptualizations and re-frames of said reasoning process, some research evidence was presented, dealing with observation and improvement of teachers' reasoning (§Chp.3.2.2), always considering the important influence of dispositions and professional knowledge in it (§Chp.3.3). In conclusion, it is to be stressed once again the need for teacher education to make clear and explicit professional reasoning for student-teachers. As Niederhauser and Stoddart (2001) described, despite the huge economic support to guarantee schools and teachers access to technologies, that it was not sufficient to enable a transformation in pedagogies. On the other hand, researchers like Smart (2016) suggest that when pre-service teachers are guided to reflect within an MPR&A framework, their pedagogical reasoning overall improves.

Authentic experiences showing how technologies can meaningfully blend with pedagogical strategies and content specifics are warranted, especially if actively engaging student-teachers in communities of inquiry (Niess & Gillow-Wiles, 2017). Implementing technologies in a system with pedagogy and content (Niess & Gillow-Wiles, 2017) and involving scaffolded procedures for critically reflect on teachers' practices (Nilsson, 2009, Smart et al., 2015; Webb, 2010) could lead to a better theoretical understanding and practical implementation of teachers' TPCK to make meaningful and effective pedagogical decisions (Smart et al., 2015).

CHAPTER 4.
RATIONALE FOR THE PRESENT STUDY

Technology integration in education largely depends on the teacher (Farjon et al., 2019) and his/her professional expertise. That is based on (but not limited to) a complex, multifaceted and situated professional knowledge (Koehler & Mishra, 2005a), which in this dissertation is identified in the *TPCK* framework (Angeli & Valanides, 2009; Mishra & Koehler, 2006). Technology integrated practices, though, while shaped in their efficiency by a solid base of teacher knowledge and skills, are continuously enabled or hindered by tacit non-rational underpinnings (Knezek & Christensen, 2018; Niederhauser & Lindstrom, 2018), in this dissertation identified in the construct of *dispositions*. Literature has widely investigated the interconnections between TPCK and pedagogical-technological beliefs (Forkosh-Baruch, 2018; Scherer et al., 2018; Tondeur et al., 2019; Voogt et al., 2012; Yeh et al., 2017) in shaping teachers' decisions to teach with technology. A successful integration, supported by strong and positive dispositions, is not only an addition of technology to existing practices, but a considered use of it (Farjon et al., 2019). Hence, it is crucial to investigate how teachers reason about their profession (Voogt & McKenney, 2017; Voogt et al., 2016). In this dissertation the construct of *pedagogical reasoning* is used to refer to teachers' decisional processes in relation to technology-enhanced practices.

From the literature described earlier (§Chp.1-3) it appears clear the importance of uncovering teachers' given meanings to technology uses in their practices (pedagogical reasoning) moulded by their professional knowledge (TPCK), learning theories' approaches and perceived affordances, and of acknowledging their inner motives and expectations (dispositions) (Brown, 2009; Heitink et al., 2016; Voogt et al., 2016; Webb & Cox, 2004). The interrelations among these three constructs, while important to understand and improve technology-integrated teaching practices, are demanding for further research.

Given these premises, the present study tries to observe closely pedagogical reasoning processes as doorway to tacit dispositions (Heitink et al., 2016) and expression of professional knowledge (Shulman, 1986,1987). As the reader will see shortly (§Section B), the broad context of this research is pre-service education, as

(a) (possible) place of origin of professional expertise where the profession's complex bodies of knowledge and skills (Shulman, 1987) are first explicitly addressed, and dispositional barriers to technology integration may be reduced (Christensen & Knezek, 2009; Farjon et al., 2019; Lee & Lee, 2014; Tondeur et al., 2012);

(b) highly influential setting, even on the long run, for technology-integrated teacher practices (Agyei & Voogt, 2011; Mouza et al., 2014; Tondeur et al., 2012; 2016).

Initial teacher programmes, as already described (§Chp.1-3), hold the great capability of fostering positive dispositions (Banas & York, 2014; Lee & Lee, 2014; Ottenbreit-Leftwich et al., 2018) and professional expertise (Baran & Uygun, 2016; Mouza et al., 2014) for technology integration in education. Particularly relevant are authentic learning experiences as design tasks, because they offer meaningful exposure to technology integration in education (Baran & Uygun, 2016; Koehler & Mishra, 2005a; Kramarski & Michalski, 2010). Design tasks actively engaging student-teachers are found powerful in making them realize technologies' potentialities for learning (Angeli &Valanides, 2009; Koehler & Mishra, 2005a; Papanikolaou, Gouli & Makri, 2014). Furthermore, the decisional processes implied to perform a design task (Kramarski & Michalski, 2015) can enlighten on student-teachers' underpinning pedagogical/technological dispositions (Angeli & Valanides, 2009) as well as their level of professional knowledge.

Nevertheless, whereas there is quite broad literature on the efficacy of design task practices for dispositions and TPCK improvement in pre-service education, it is still unclear if and how these tasks can engage some sort of pedagogical reasoning. Teaching finds a core practice in design (Laurillard, 2012), and teacher education has the ultimate goal to educate teachers to soundly reason about their teaching as well as to perform it skilfully (Mishra & Koehler, 2006; Shulman, 1987), using their professional knowledge as ground base for aware choices and actions (Mishra & Koehler, 2006). For these reasons the present research operates on pre-service level to investigate how TPCK-informed design tasks may engage student-teachers' pedagogical reasoning, considering their implicit dispositions on the matter of technology integration in education.

By investigating student-teachers' reasoning processes, influenced by their dispositions and expressed through design tasks within a TPCK perspective for teacher knowledge, the present research wants to provide empirical evidence for a better understanding and fostering of technology-integrated teaching practices, to the service of initial education programmes, scholars, practitioners and policy makers.

SECTION B.
RESEARCH OUTLINE

SECTION INTRODUCTION

Pedagogical reasoning (PR) is deemed to be a powerful doorway to connect teachers' inner educational theories with intended and actual technology integration practices (Heitink et al., 2016). As mentioned in §A-Chp.4, this research wants to address the specific gap in the literature regarding the possible connection between PR and TPCK-informed design tasks available in preservice education. The main aim of the research is to empirically investigate student-teachers' reasoning[1] in technology-integrated design practices (§Chp.1).

Given the complexity of the phenomenon and the contextual influence on it (i.e. the specific academic strategies used), this research takes the form of a multiple case study (§Chp.2). The different cases (§Chp.4) observe peculiar manifestations of the phenomenon in order to understand it better and provide more stable results (Stake, 2006). Furthermore, as explained in §Chp.2, the present multiple case study embeds a convergent parallel mixed methods design (Creswell, 2013) regarding a specific sub-question of the overall research (§Chp.1): student-teachers' dispositions towards ICT integration. The intent of this was to develop a richer understanding of the non-rational component that plays a role in the decisional process for ICT integration within the overall investigation on pedagogical reasoning in technologically-integrated design practices.

In this section the present research will be described in its specific questions (§Chp.1), design (Chp.2), methodology and instruments for data collection (§Chp.3), and participants (§Chp.4).

[1] As the reader might recollect from §A-Chp.3, pedagogical reasoning refers in this dissertation to the decisional process (Shulman, 1987; Starkey, 2010 in particular) occurring in the definition of a technologically-integrated learning unit, as informed by personal dispositions towards ICT integration (e.g. Ottenbreit-Leftwich, Kopcha & Ertmer, 2018; Niederhauser & Lindstrom, 2018).

CHAPTER 1.
RESEARCH QUESTIONS

As described in the previous section (§A-Chp.4), the present research aspires to address the gap in the literature regarding empirical evidence for pre-service teachers' pedagogical reasoning in technology-enhanced instructional design practices. More specifically, it observes this phenomenon in pre-service education contexts, where teacher professional expertise is explicitly addressed (§A-Chp.4). The main question leading this study was:

How can TPCK-informed instructional design tasks, as implemented in initial teacher education, engage student-teachers in pedagogical reasoning?

Within such inquiry, the following sub-questions were considered:

Sub-question 1: *How are instructional design task procedures characterized in terms of ICT integration and PR references?*

This sub-question explores the academic strategies and procedures for instructional design offered in initial teacher education contexts. The aim was to identify the intended connections to theories/models for technology-integrated practices and pedagogical reasoning.

As will be clear in the next chapters (§Chp.2, 3), this sub-question was addressed within the qualitative multiple case study (Creswell, 2013; Yin, 1994) through strategies of document analysis, participant observation and focused interviews.

Sub-questions 2a: *How are student teachers' dispositions toward ICT integration characterized?*

And 2b*: How are their dispositions characterized after multiple experiences with TPCK-informed design tasks?*

These sub-questions deal with dispositions towards ICT integration, acknowledged in their role of barriers/enablers of technology-integrated behaviours (Ertmer, 2005; see also §A – Chp.2). Student-teachers' dispositions in this research were investigated to uncover what is usually a tacit component to decision-making processes (see theories like *Planned Behaviour* by Ajzen, 2012 and other references in §A-Chp.2). Their inquiry was thus to the service of a deeper understanding of pedagogical reasoning instances, main focus of the present study.

These sub-questions were investigated through a mixed method design embedded in the multiple case study (§Chp.2), with strategies of focused interviews and pre-/post-questionnaires (§Chp.3).

Sub-questions 3a: *How are PR dimensions activated in student-teachers, when performing a TPCK-informed design task?*
And 3b: *How do PR dimensions appear in student-teachers, after multiple experiences with an ICT informed design task?*

These sub-questions deal with technological pedagogical reasoning, the decisional process related to technology-enhanced educational practices (see §A-Chp.3). Student-teachers' PR, in its overall dimensions and inner steps[2], was investigated in light of the theoretical references earlier described (mainly Shulman, 1987; Starkey, 2010; see §A-Chp.3). The aim here was to explore any form of PR expressed by student-teachers during their design tasks, with minimal attention for the task's structural specificities (addressed in sub-question 1). These sub-questions were investigated within the qualitative multiple case study (Creswell, 2013; Yin, 1994) through strategies of participant observation and focused interviews (§Chp.2;3).

As will be introduced in the next chapter (§Chp.2), the main research question was investigated in multiple instances (cases), so to gather more robust data to inform its answer. Considering the different cases, then, a further sub-question emerged:

Sub-question 4: *Which are, if any, the shared patterns across case studies, regarding*

- *Initial teacher education programme's strategy for TPCK-informed instructional design tasks (design procedure's structure);*
- *ICT-related dispositions' characteristics and modifications through multiple design tasks;*
- *PR characterization and modification through multiple design tasks.*

Still considering the single cases' unique features, specific attention was here drawn to patterns of evidence which could enrich the understanding of the main question. As the answer to this inquiry relies on single cases' evidence, it was addressed within the qualitative multiple case study, considering also the embedded mixed method study, in a cross-case analysis perspective (§Chp.2).

[2] For the specific structure of pedagogical reasoning (i.e. dimensions and steps) considered to inquire student-teachers' decisional processes, please see §B- Chp.3.1.

CHAPTER 2.
RESEARCH DESIGN AND OVERALL METHODOLOGY

2.1 RATIONALE TO THE RESEARCH APPROACH

The approach to the present research is defined by philosophical assumptions, research design and specific methods (Creswell, 2013). Each component[3] will now be briefly described.

The philosophical assumptions underlying the study are related to social constructivism and pragmatism. Constructivist perspective in research considers meaning as developed by individuals through their experiences and aims to rely as much as possible on participants' views on the situation under study (Creswell, 2013). Moreover, a pragmatic perspective in research requires to emphasize the problem over the methods (Rossman & Wilson, 1985) allowing for multiple techniques, procedures and methodologies to best answer the research question. Both these perspectives are accountable for the attention, in the present research, to participants' viewpoints on (a) their academic-based tasks (sub-question 1 - §Chp 1); (b) the value attributed and affective approach to ICT in education (sub-question 2 – §Chp.1); and (c) their very own individual PR expression in the specific design task (sub-question 3 - §Chp.1).

The main research question intrinsically recognizes the influence played by the specific situation (pragmatist perspective) in shaping subjective meanings (constructivist perspective), calling for aligned research design and methods. The chosen research design is complex, taking the form of a multiple-case study nestling a parallel mixed methods investigation. Before describing these two research strategies in detail (§Chp.2, 2.3) and outlining possible strengths and weaknesses in their implementation (§Chp.2.4), some more details about the rationale to their choice.

Case study approach to research, according to some of its more relevant authors (Stake, 1995; Yin, 2003), is based on a constructivist paradigm in which while participants describe their views on reality, the researcher understands better their actions within the peculiar context (Baxter & Jack, 2008). Moreover, this approach strives to report the "complex dynamic and unfolding interactions of events, human relationships and other factors" (Cohen, Manion & Morrison, 2000, p. 181) within each unit of investigation (case). Theoretically, a case study inquiry should be chosen according to three main criteria (Yin, 1993, 1994, 2008):

- when the main research question is a *how* or *why* one. As the reader might recall from the previous chapter (§Chp.1), the present inquiry seeks to understand the ways and characteristics

[3] While methods will be introduced in this chapter, the specifics of data collection instruments and data analysis strategies will be addressed in §Chp.3.

of a possible connection between TPCK-informed design tasks and technological-pedagogical reasoning;

- when the researcher cannot (or would not) manipulate the behaviour or its setting. The present research does not imply any experimentation, wanting to observe the phenomenon of PR expression during TPCK- informed design tasks in a natural setting (i.e. usual initial teacher education program's routine);

- when the boundaries between phenomenon and context are not readily distinguishable. Still considering the main research question (§Chp.1) as well as the constructivist paradigm, the phenomenon under study (PR expression) is expected to be influenced by the activity in which it is observed (TPCK-informed design task) and even more by the overall context in which such activity takes place (specific initial teacher education program).

Considering the abovementioned parallelisms between theoretical criteria and present research's characteristics, the case study (specifically a multiple case study) was identified as a suitable approach to investigate the topic at stake (Yin, 1981, 1993; Stake, 2006). Following Yin's (1994) suggestion, the choice between single or multiple case study is to be considered a research design choice, within the same overarching methodological framework. For this reason, the description and rationale for multiple case study will be addressed in §Chp.2.2.

Finally, the mixed method approach to the research finds full legitimation in the case study's reliance on multiple sources of evidence (Stake, 2006; Yin, 1994), as well as in the pragmatist's procedural pluralism (Creswell, 2013; Rossman & Wilson, 1985). The present study sought for both in-depth understanding of the topic (mainly through qualitative methods) and a base for analytic generalization (Cohen et al., 2007; Robson, 2002). While the second was pursued also through case replication (§Chp.2.2, 2.4), quantitative methods could provide a further reliable basis for cross-case comparison (Yin, 1993). A mixed methods perspective was thus chosen to have a clear methodological strategy to triangulate quantitative and qualitative data and support the overall qualitative evidence gathered in the (multiple) case study. Specifically, a convergent parallel mixed method design was implemented, as it will be described shortly (§Chp.2.3).

2.2 MULTIPLE-CASE STUDY RESEARCH DESIGN

Multiple case study research is a strategy of inquiry seeking to gain a better understanding of the phenomenon at study (here, PR in TPCK-informed design) through the evidence emerging from its multiple and diverse manifestations (cases – Stake, 2006). While each case is a complex entity with a specific contextualization and connection to the overall phenomenon (Stake, 2006), analysing multiple ones could reveal compelling and robust explanations to the event itself (Yin, 1994).

Yin (2008) ponders on the ties of (multiple) case study research and the qualitative/ quantitative methodological continuum. He observes how (multiple) case study has been recognized as a viable choice for qualitative research (Creswell, 2013; Creswell & Poth, 2017), but its requirements for a clear definition of case units, triangulation among multiple sources of evidence and capability to include quantitative data make this research strategy's distance to quantitative research more nuanced. Moreover, given such strive to triangulate data from multiple sources, both qualitative and quantitative, the implementation of mixed methods designs is deemed as viable choice within multiple case studies (Creswell, 2013; Yin, 2008).

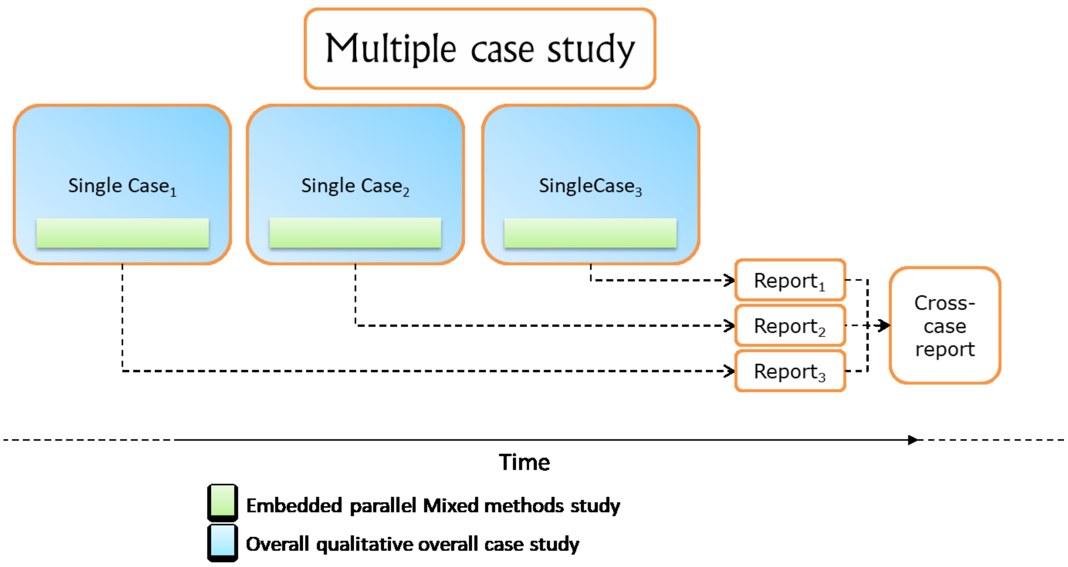
A multiple case study's design begins with the identification of the units of analysis (the cases), which should answer to specific criteria in order to produce findings that could eventually corroborate a generalization to similar cases focusing on the same phenomenon (Yin, 1993). As already mentioned, cases are situated manifestations of the phenomenon, each characterized by temporal, geographical, institutional and social boundaries (Cohen et al., 2007). Yin (1994) recommends considering each case as a single experiment, following a replication, not a sampling, logic. That way, single instances (cases), treated as a whole, could report on the occurrence of the phenomenon, but cross-case analyses would indicate its extent according to set conditions (Yin, 1994).

Stake (2006) mentions three main criteria to select a case: relevance to the main issue at study; potential for diversity across contexts; and potential for opportunities to learn about these contexts and complexities. In the present research, relevance to the issue of student-teachers' PR in TPCK-informed design tasks was determined according to (in detail in §Chp.4):

- Belonging to the European context;
- Contextualized in pre-service teacher education institutions as Universities;
- Set in university courses within the pre-service education curriculum, dealing with the topic of technology integration in teaching and learning; and
- Presenting, in the natural setting, occasions for student-teachers to actually perform technology-integrated instructional design.

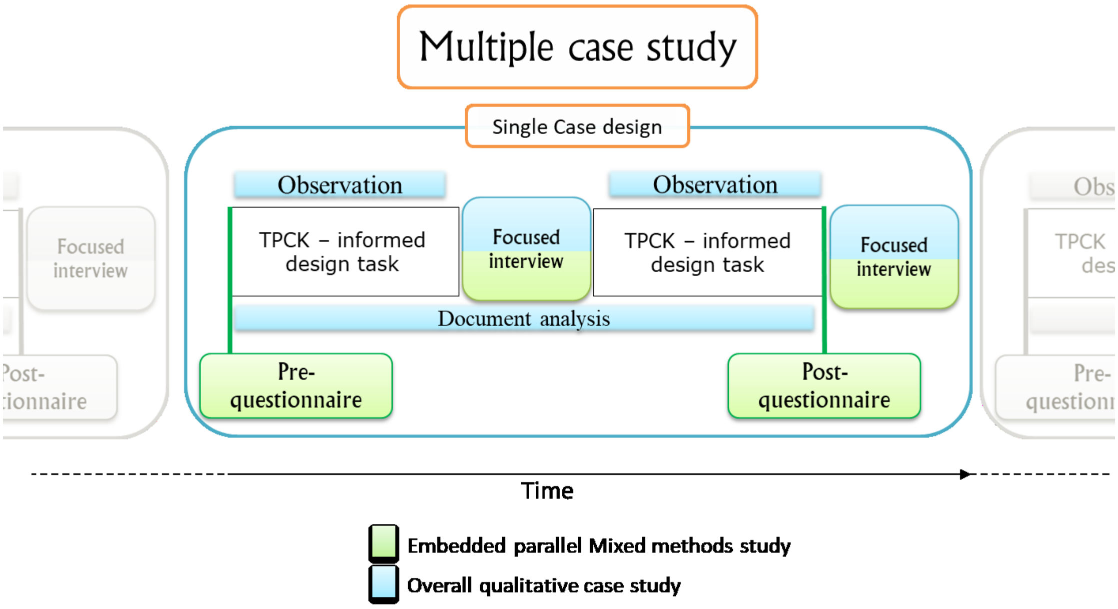
As the reader can infer from these bullet points, there is a margin for differentiation in the actual identification of the cases, eventually set in Cyprus, Italy and The Netherlands, each with peculiar history, educational policies and social environments even if all potentially presenting the phenomenon. Finally, as Stake (2006) suggests, priority should be given to cases that "offer the opportunity to learn a lot" (p.25), hence sometimes the most accessible to the researcher. For this reason, when considering the pertinence of the abovementioned three contexts, it was also pondered the researcher's capability to spend time in each one to study the case's specifics. For further details about the cases' identification process and characteristics, the reader would be invited to §Chp.4.

Going down to the specifics of the research design (Picture 2.1) the three cases were identified as part of the multiple case study, following a methodological strategy inspired by the case-comparison approach (Yin, 1993), in which (a) each single case is explained and analysed as a whole; and (b) in a second time a common explanation is provided, through the comparison of the single lessons learned and the consideration of the context-required modifications. The logic underpinning cross-case analysis wants to consider what Stake (2006) calls the case-quintain dialectic. Here, single cases are instrumental to the main interest in studying the overall phenomenon (*quintain* – Stake, 2006). Nevertheless, despite the risk to overlook cross-case binds, a local orientation is an important first step for grounding the phenomenon at study in actual realities (Stake, 2006).



Picture 2.1 Research design - Multiple Case study.

As visible from Picture 2.1, each case is characterized by an overall qualitative orientation but presents an embedded mixed method part (§Chp.2.3). The design implemented systematically in every case is further detailed in Picture 2.2.



Picture 2.2 Research design - Single case design.

The core to each case study is the TPCK-informed design task, which happens twice in the time-slot of 5-6 months allowed for each context (see §Chp.4). This choice accounts for the intent to observe closely the PR manifestation in real situations, gathering in-depth data through multiple sources (i.e. observation protocols, document analysis and focused interviews - §Chp.3). Furthermore, the permanence of the researcher in the context for the whole duration of the two design cycles made it possible to reduce reactivity effects (Cohen et al., 2007), increasing in participants' familiarization with the researcher herself, while enhancing the reliability of interview and observational data (§Chp.3).

A participant observation was carried out all through the two design cycles and comprised also the exploration of the academic context in which they were embedded, so to provide a background framework of interpretation of contextually-defined characteristics, and better answer to sub-question 1 (§Chp.1). To the same aim concurred the analysis of institutional documents and student-teachers' materials, similarly carried out all through the case study. Focused interviews, on the other hand, were held at the end of each design cycle, trying to capture student teachers' PR and dispositions to ICT integration through think-aloud techniques (van Someren, Barnard & Sandberg, 1994), to provide an answer to sub-questions 2 and 3 (§Chp.1). For more details about these instruments for data collection, and the analysis procedures followed, please consider §Chp.3.

2.3 EMBEDDED MIXED METHOD STUDY DESIGN

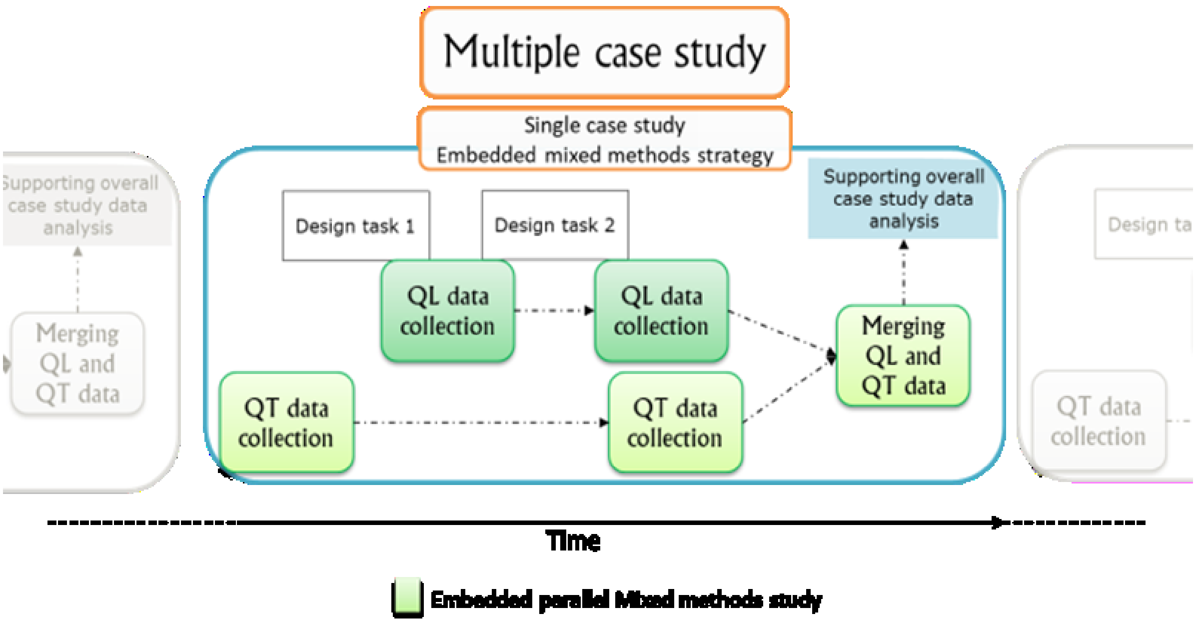
As mentioned earlier, this research embeds a mixed method section in each case within the multiple-case study (see Picture 2.2). The connection between mixed methods strategies and case studies is acknowledged in the literature (Baxter & Jack, 2008; Cohen et al., 2007; Creswell, 2013; Stake, 2006; Yin, 2008), due to the latter's strive for data triangulation, and to the former capacity to provide multiple-perspective explanations (Creswell, 2013; Jick, 1979). In this research, the choice of a mixed method design embedded in the overall qualitative case study research answers two purposes:

- Investigating participants' dispositions towards ICT integration (sub-question 2 - §Chp.1), given their influence on technologically-integrated behaviours as reported in the literature (see §A-Chp.2); and

- Providing a detailed, in-depth view of the issue while ensuring a base for comparison, useful to the overall cross-case analysis.

Due to the width and relevance of the topic, the focus on dispositions could have been easily a separate research project. Here, it was intended to account for the specificity of the issue and its own theoretical boundaries, while relating it to the main focus of the study (PR). This is why the investigation of participants' dispositions was used just to broaden and corroborate the answer to the main research question on student-teachers' PR for technology integration (§Chp.1).

Picture 2.3 displays the design details for said mixed method section within each case in the multiple-case study.



Picture 2.3 Research design - Embedded mixed method study.

The specific design chosen was a convergent parallel mixed method one (Creswell, 2013), in which quantitative and qualitative data based on the same constructs (i.e. dispositions towards ICT integration), were gathered separately but in the same time-slot (namely, the 5-6 months abovementioned – see also §Chp.3) and only then merged to provide a comprehensive examination of the issue. In particular, a pre- and post- questionnaire was administered to the whole population of the identified case (§Chp.3.4), while focused interviews to a part of it accounted for the qualitative side (§Chp.3.3). The difference in sample sizes was not considered an issue because of the different aims of the two databases: the qualitative to give an in-depth view of the topic, and the quantitative to provide a base for cross-case generalization (Creswell, 2013). In the analysis, a side-by-side comparison strategy was used to see any convergence or divergence between the two sources of information (Creswell, 2013). For more details about these instruments for data collection, and the analysis procedures followed, please consider §Chp.3.

2.4 Limitations of the chosen research approach and design, and their solution

Any choice of research approach and design needs to ponder over its potentialities and limitations, both theoretically and operationally.

Constructivist and pragmatist assumptions share the risk of falling into relativism, as they are founded on the individuals' meaning-making processes in socially situated conditions. As perceivable, it could be easily argued that each and any finding could be simply based on multiple-level misunderstandings (participants, researcher, reader even), or, even if proven reasonably unbiased, strictly linked to the specific conditions that enabled it. This research does not presume to dismantle these issues altogether, recognizing instead as a premise the strong contextual binds to any case's evidence. Nevertheless, while it uses those situated, relative meanings to inform the answers to the research question, it also strives for an analytic generalization (Cohen et al., 2007; Robson, 2002). This type of generalization, typical of case studies, aims to develop an empirically-based theory to the service of researchers in understanding similar phenomena or situations (Robson, 2002).

Case studies themselves have been criticized for an impressionistic attitude (Shaughnessy, Zechmeister & Zechmeister, 2003), too often combining knowledge and inference with low control over their boundaries (Dyer, 1995). Once again, lack of generalizability and bias are indicated as possible weaknesses of this research approach (Cohen et al., 2007; Nisbet & Watt, 1984). Even the commonly used (and evermore required) data anonymization process, while moving in the direction of a more objective perspective, could imply such a distortion in the portrayal of the uniqueness of cases, to make it inconsequential (Adelman, Kemmis & Jenkins, 1980; Cohen et al., 2007; Dyer, 1995). In order to answer these issues, Yin's (1993) suggestions were considered to ensure and enhance (multiple) case studies':

- Construct validity, as the definition of operational measures to observe the topic at study. In (multiple) case studies, this can be achieved in three ways:

  - ✓ Triangulating multiple sources of evidence. The present research uses multiple qualitative instruments for data collection (§Chp.3), as well as an inherently-triangulated strategy as the mixed methods one (§Chp.2.2). Triangulation, as Stake (2006) suggests, exists also across case studies in the form of credibility of findings (see Lincoln & Guba, 1985) and conclusions in the multiple-case studies design, as in our sub-question 4 (§Chp.1);

  - ✓ Establishing a chain of evidence in which each and any finding can be traced back from cross-case, to within-case data analysis, to data collection, thanks to explicit mention of the particular pieces of evidence underlying it. The researcher took into high consideration this point in compiling every part of the present dissertation;

  - ✓ Having the case data reviewed by key informants, enabled to comment and/or corroborate pieces of evidence in the data. The present research addressed this point especially when treating sub-question 3 (§Chp.1) through the interviews (§Chp.3.3).

- External validity, as the definition of the boundaries in which a study's findings can be generalized. In particular, (multiple) case studies rely on analytical generalization in which a case's findings could be virtually extended to a particular set of other cases (Robson, 2002; Yin, 1994). The present research addresses this concern through the replication of the exact design in multiple cases (§Chp.2.2, 2.3), exploring the most constant findings (commonalities) among them (sub-question 4 - §Chp.1).

- Reliability, as the consistency of data collection procedures which should allow a future researcher to arrive at the same conclusions. Yin (1994) highlights that this pertains to "doing the same case over again, not replicating the results of one case by doing another case" (p. 36). As the need is to minimize errors and biases, once again the solution is found in documenting the procedures as much in detail as possible. The researcher tried to account for this in compiling the germane chapters of the present dissertation (§Section C), as well as replicating the same procedural protocol in each case study (see design §Chp.2.2, 2.3).

Notwithstanding the researcher's strive to address the abovementioned criteria to ensure research quality, limitations to the present study cannot be denied, and will be presented in §Section E.

CHAPTER 3.
STRATEGIES FOR DATA COLLECTION AND ANALYSIS

In this chapter, the means for data collection and germane analysis procedures adopted will be presented. As described in the previous chapter, this research figures as a qualitative multiple case study in which instruments like documentation, observation, and focused interviews were used to gather in-depth data on the main topic at study. Additionally, in the embedded mixed method design within each case study (§Chp.2), a questionnaire was also implemented. Given the use of several sources of data, their description will be organized according to the type of instrument adopted, describing each in its (a) purposes and rationale; (b) sources and characteristics; (c) procedures of administration; (d) data analysis strategies; and (e) limitations in the adoption, use and/or analysis strategies implemented (also considering validity and reliability issues).

3.1 DOCUMENTATION

Data collection through documentation was implemented as a means to answer the first research sub-question about academic strategies and materials dealing with ICT integration and PR (§Chp.1; Box 3.1)[4].

Box 3.1 - Documentation data collection.

Research question to address	Sub-question 1 (§Chp.1): *How are instructional design task procedures characterized in terms of ICT integration and PR references?*
Information gathered concerning	Context information on University program organization: setting, contents, equipment, attendants. University program teaching materials for instructional design
Specific materials analysed	Organization-provided documents and official reports (public); Teaching materials, e.g. instructional design tasks and procedures (public).
Sources	University websites; Course Professors.
Time of implementation	Documents were collected through the 6 months courses' duration
People involved	Researcher (active collection and analysis); sources (providing access and permission of use).
Limitations encountered	Access to documents; translation.

Data collected through document analysis helped preliminarily to gather evidence on the academic context in terms of university course organization (physical setting, access, contents, assessment strategies - §Chp.4). While this goal seems not directly connected to the research sub-question, these data helped the researcher obtaining access to language and words of the participants (Creswell, 2013) in an unobtrusive way (Yin, 1994). In agreement with the constructivist perspective underlying the multiple case study approach (Baxter & Jack, 2008), understanding the context in which participants would build their meanings was a crucial step in the present research. Documents were

[4] These sources were triangulated with observations in order to corroborate the answer to that sub-question of research (§Chp.3.2).

analysed for relevant information about academic courses' qualification according to van den Akker's (2003) dimensions for curriculum analysis: *rationale* (central mission and principles of the course); *aims; contents; learning activities; teacher role, materials, grouping, location, time* and *assessment*.

Moreover, and more importantly, documentation data collection enabled the researcher to assemble information on the teaching materials used, especially regarding the TPCK-informed design tasks and germane procedures offered to student-teachers. As perceivable, this was the core source of documental information to better answer the research sub-question at stake (§Chp.1). Data collection took place all through the course of the single cases, whenever access to the researcher was granted. Documents were analysed as soon as gathered and, when relevant, used to tailor the lexis in the interviews' questions (§Chp.3.3). Documents' content was analysed for relevant themes, specifically: definitions provided to the design tasks procedures' items; theoretical references made to the TPCK framework and/or other ICT integration models; theoretical references made to pedagogical reasoning models and dimensions (e.g. Shulman, 1987; Starkey, 2010).

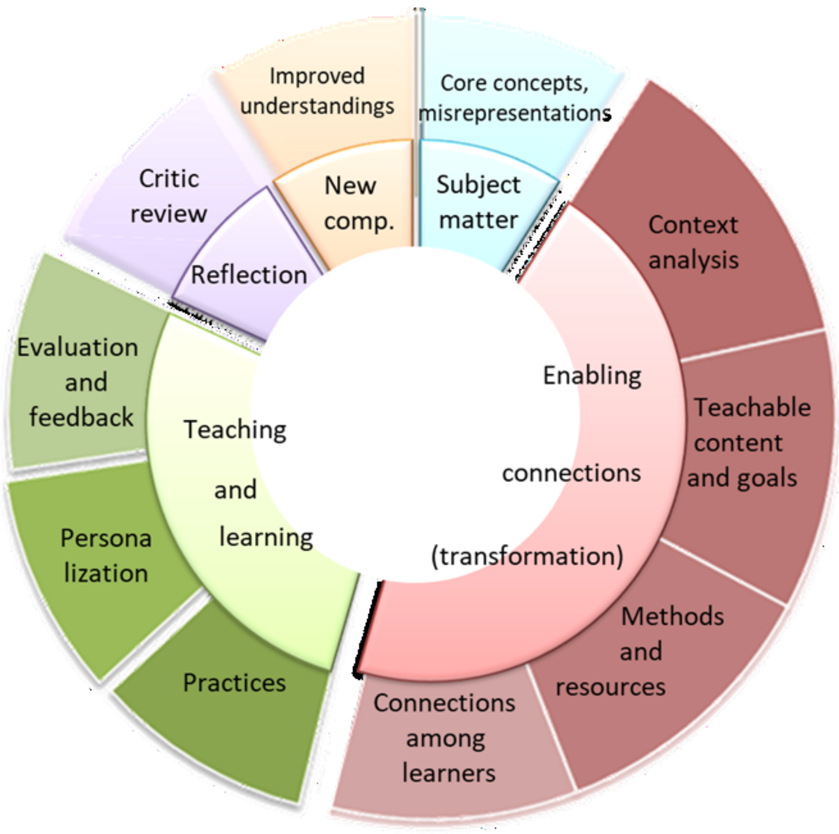
Considering the problematic theoretical agreement about what pedagogical reasoning for technology integration (PR) may look like (see §A-Chp.3), the basis of the chosen interpretative lens was found in the most widely accepted one: MPR&A[5] by Shulman (1987, see §A-Chp.3). Furthermore, in the attempt to account more explicitly for any possible technology-related declination of such reasoning process, Starkey's MPR&A-DA[6](2010) was considered as, while still based on Shulman, opens to further digital reasoning implications (§A-Chp.3). A theoretical reference for data analysis based in MPR&A and clearly considering the role of new technologies (MPR&A-DA) seemed a suitable instrument to enlighten the comprehension of the documents and the tasks. Such adapted reasoning model (visible in Picture 3.1) included several dimensions and inner steps:

- *Comprehension of subject matter*: as identification of the broad discipline boundaries and core concepts, as well as its misrepresentations (from the teacher point of view). It includes substantive and syntactic knowledge of the discipline (Starkey, 2010) in consideration of the broad educational goal of fostering individual excellence while ensuring opportunities for equity and equality among different pupils (Shulman, 1987)[7].

[5] *Model for Pedagogical Reasoning and Action* (Shulman, 1987).

[6] *Model for Pedagogical Reasoning and Action for the Digital Age* (Starkey, 2010).

[7] The link between subject matter comprehension and educational broad aims "transcends the comprehension of particular texts, but may be unachievable without it" (Shulman, 1987, p.15).



Picture 3.1 PR adapted model in design tasks.

- *Enabling connections (transformation):* as a process of conversion of expert knowledge into teachable content, moving from "personal comprehension to preparing for the comprehension of others" (Shulman, 1987, p. 16). It includes:

    - Analysis of the contextual characteristics aimed to adapt ones' teaching to pupils' specific needs. Here, the teacher would reason about how to fit the material to specific pupils, acknowledged in their abilities, gender, language, motivations and so forth. (Shulman, 1987). This seems particularly important as pupils' expectations, motives and misconceptions might influence their approach to understanding or misunderstanding the material (Shulman, 1987).

    - Identification of how teachable content looks like (Starkey, 2010): in pursuing a merge between expert subject matter knowledge (of the teacher) and situated needs (of the students), the educator should identify suitable specific educational purposes or goals (Shulman, 1987) related to content, abilities, skills, and so forth.

    - Selection of adequate resources and teaching methods to engage pupils' previous knowledge and build a new one (Starkey, 2010). Here, the teacher would identify pedagogically powerful and yet adaptive means to best ensure pupils' learning, choosing from an array of teaching methods and models (Shulman, 1987). Along with these, a clear selection of resources needs to be made to assure teaching efficiency, and these may include (non)technological materials, tools and instruments critically analysed in their content-pedagogical affordances.

- Endorsement of connections among groups and individuals to develop new knowledge (Starkey, 2010). This accounts for the constructivist (Shulman, 1987) and connectivist (Starkey, 2010) perspectives on learning, which put pupils at the centre of the learning experience, actively building their knowledge by transforming their naïf one, and benefitting from negotiation and knowledge/experiences sharing practices with the broader community.

- *Teaching and learning*, as the most visible part of the decisional process, including:
  - Classroom-based practices (Shulman, 1987), like classroom organization and management, learning events/activities, content exploration, teacher-student interactions, and so forth. Here, it is also more visible the implicit learning theory of the teacher, informing his/her pedagogical style and the role assigned to pupils and learning (Shulman, 1987).
  - Personalization practices, in the tailoring of approaches, materials and methods to address the content, according to unexpected/emerging situated needs (Shulman, 1987; Starkey, 2010). This point accounts for the flexibility needed in teaching as a process situated in ill-structured, ever changing conditions.
  - Assessment and feedback practices, including formative and summative evaluation forms (Starkey, 2010). Here the teacher would reason about how to check for (mis-) understanding in his/her pupils, acknowledging implications of both content goals at stake and learning processes enacted (Shulman, 1987).
- *Reflection*, as critic review and analysis of teacher's decisions (Starkey, 2010). It is the ideal birthplace for experience-based professional learning (Shulman, 1987), as it comprises a critical approach to decision analysis, noticing their consequences on learning by practice evidence.
- *New comprehension* about students, teaching processes and content (Starkey, 2010), achieved through teaching acts that are *reasoned* and *reasonable* and sustained by strategies of documentation, analysis and discussion(Shulman, 1987, p. 19) .

According to the original sources and wider literature, this adapted model is not to be thought as linear but rather fluid and recursive, as educators may skip from one dimension to another in any subjective order (Shulman, 1987), and/or might reason on one dimension's issue while making decisions related to another (e.g. being aware of *Reflection* while deciding about /performing *Classroom-based practices*).

Such adapted PR model was used as lens to analyze documentary data, seeking to identify in their content any keyword and/or theme relatable to the reasoning dimensions and inner steps abovementioned (top-down perspective). This, to detect any possible documentary-based link between design tasks and reasoning engagement (as per main research question – §Chp.1). The thick description (Cohen et al., 2007) emerging from this data can be found in the cases' individual reports (§Section C).

About the strengths and weaknesses in documentation as means for qualitative data collection, several authors point out that it figures as a powerful source for information, especially if used to corroborate other evidence (Creswell, 2013; Lincoln & Guba, 1985; Tellis, 1997). This type of data has the virtue to be stable and precise (Yin, 1994), allowing for unobtrusive access to participants' language and representing data to which participants actually gave attention (Creswell, 2013). On the other hand, availability and possible bias in the selection of the documents (Tellis, 1997) could hinder data validity, and the researcher may have to deal with issues of inaccuracy and restricted information. The present research tried to take advantage of the main strengths of the documentation technique to gather data while minimizing its weaknesses. In particular, the researcher collected every teaching document publicly shared by the university or the course Professor, in the attempt to minimize bias in selectivity, although access was not always granted in every case study (see §Section C). Furthermore, documents were compiled in the native language of the cases' contexts, posing the issue of translation accuracy. This was addressed through the careful translation in English made by either a certified translator (Cypriot case study) or a native-speaker researcher with no ethical impediments to access the data (Italian and Dutch case studies). Translated versions of the documents were then reviewed by key informants for approval.

Finally, the key informants agreed upon sharing the documents with the researcher, in their use for the present research, granting permission for academic purposes provided that names would be masked.

3.2 OBSERVATIONS

Box 3.2 Observation data collection.

Research question to address	Sub-question 1 (§Chp.1): *How are instructional design task procedures characterized in terms of ICT integration and PR references?* Sub-questions 3a/b (§Chp.1): *How are PR dimensions activated in student-teachers, when performing a TPCK informed design task? How do PR dimensions appear in student-teachers, after multiple experiences with an ICT informed design task?*
Information gathered concerning	Context information on University program organization: setting, contents, equipment, attendants. Pedagogical reasoning (think aloud) in relation to the design procedure used.
Specific instrument	Protocol notes.
Sources	Creswell, 2013; Cohen et al., 2007
Time of implementation	Notes taken every lesson of the university course in which the design tasks took place
People involved	Researcher (observer); key informants (student-teachers)
Limitations encountered	Selectivity, time consuming.

Data collection through direct observation (Cohen et al., 2007) was implemented as a means to answer to the first research sub-question about teaching strategies and materials dealing with ICT integration and PR (§Chp.1; Box 3.2)[8]. Additionally, it corroborated the answer to sub-question 3 on pedagogical reasoning, along with the interviews (§Chp.1, 3.3).

Observation helped preliminarily to gather data on the organization of the university course in which the design task was embedded (§Chp.4): physical setting, programme setting (resources, organization, pedagogical styles) and students' characteristics (attendance rate, grouping, non-verbal behaviour[9]) (Morrison, 1993). Then, and more importantly, it served to assemble information on participants' pedagogical reasoning through think aloud-based evidence (van Someren et al., 1994) collected while participants were completing their design task using the given procedure (see §Chp.4.1-4.3). Within this goal, the most frequent issues brought up by the participants when performing the design task were tracked, in terms of ease/difficulty in the use/understanding of the task itself. In so doing, the researcher wanted to have a further base of information for sub-questions 1 and 3 (§Chp.1).

Within the purposes of the present research, observation was chosen as a strategy to enter and understand better the situation to be described (Patton, 1990). While a non-interventionist approach (Adler & Adler, 1994) was implemented to minimize the context manipulation, the research recognized the assumption that "all research is some form of participant observation since we cannot study the world without being part of it" (Cohen et al., 2007, p.397).

The specific type of observation in place was then characterized by being (Cohen et al., 2007):

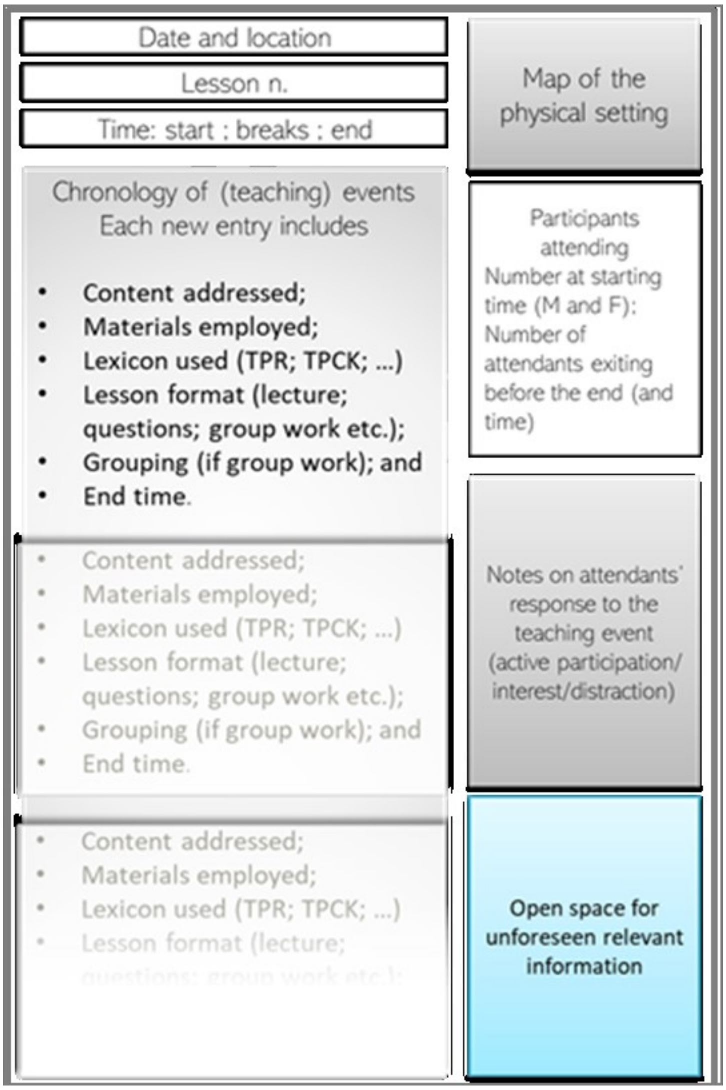
[8] These sources were triangulated with documentation in order to corroborate the answer to that sub-question of research (§Chp.3.1).

[9] As will be described shortly, non-verbal behaviour was tracked only on class-level and in relation to the evidence for attention to the teaching event in progress at the time.

- direct: the researcher was personally present in the field to track selected events and issues. While this could raise the risk of bias from the observer, a protocol that will be described shortly tried to minimize the issue;

- participant, but non-interventionist: the researcher's role was known to participants and observation lasted for an extended period of time (5-6 months, the duration of the whole university course studied[10]), but no proactive intervention was implied. This helped in the gathering of in-depth, authentic empirical evidence by diminishing reflexivity (Tellis, 1997) and reactivity (Cohen et al., 2007) of the observed participants.

As mentioned, observation lasted for the whole university course at study (approximately 5-6 months) and took place during lecture and workshop sessions occurring in the context (§Chp.4.1-4.3). In each case study, at the beginning of the university course, the researcher was introduced to the student-teachers in the overall role of PhD student interested in teacher education. After that, the researcher would sit in the back of the classroom (lecture sessions) or wander among groups of students (workshops/group work sessions), taking notes. It was not known to the student-teachers the extent to which the researcher could understand their native language, as she communicated only in English. This choice enabled them to interact more freely among themselves, reducing still reactivity effects (Cohen et al., 2007).



Picture 3.2 Observation protocol example (lecture).

The observation protocol implemented was semi-structured, aimed at addressing the goals of data collection while being open to any relevant information emerging from the

[10] For the specific duration and further details please see single cases' reports in §Section C.

context (see Picture 3.2[11]). Following the commonly acknowledged literature on observation methodology (Cohen et al., 2007; Moyles, 2002), the protocol for observation included:

- contextual setting: environment arrangement (through a sketch – Lincoln & Guba, 1985); date and session number (along the 11-13 course weeks - §Chp.4); timeframe of the session;
- participants involved: overall number, male and female presence, late entries and early exits;
- chronology of
  - teaching events (lecture session), with specifications of the main content and lexicon used to address it (e.g. theoretical references), materials employed (e.g. PowerPoint presentations, hard copy materials), main teaching methodology (lecture, questioning, open dialogue or group activity), and timeframe; or
  - learning events (workshop/group work design session), with specification of the main issue (design task process: initial, intermediate, conclusive session); instances of lexicon related to the design procedure combined with keywords like "I do not know how", "I do not understand", "what does it mean" and similar; materials employed (e.g. personal/institutional devices, internet, hard copy materials), and timeframe.
- Notes on non-verbal behaviours (Bailey, 1994) only in relation to participation to the session and recorded on classroom-level for lecture session (tracked when observed for approximately more than 25% of attendees), on group level for group work/workshop sessions. These notes were taken once for each teaching/learning even recorded, 5 and 10 min into the event. Three types of behaviour expressions were considered:
  - Active participation: e.g. eye-contact with the main speaker, comments on task, asking questions on the topic. This was formulated as "interest" in sessions where it was not required to student-teachers to be proactive (e.g. lectures);
  - Distraction: e.g. no-eye-contact for at least 2 min, use of the phone for social media (e.g. taking a selfie), chatting with the neighbours when not required by the task.
- Contextual emerging relevant data.

[11] Picture 3. represents the usual protocol outline for a lecture session ("teaching event") observation, helpful mainly for contextual information. When investigating participants' PR during design tasks, the central part of such protocol would be focused on tracking the instances of participants' doubting about the meaning of instructions and/or having difficulties completing them (see "learning events" below).

Notes taken through said protocols were analysed for relevant information in relation to the first and third sub-questions (§Chp.1, top-down perspective). The thick description (Cohen et al., 2007) emerging from such analysis can be found in cases' contextual characterization (§Chp.4.1-4.3) and individual reports (§Section C), triangulated with documentation (sub-question 1 – §Chp.1) or focused interviews (sub-question 3 – §Chp.1).

As for the strengths and weaknesses of observation as strategy to collect data, the researcher tried to build on its potential *strength on reality* (Cohen et al., 2007). Being capable to have situated, first-hand information and to record it as it occurred were among the main advantages sought for in the choosing of direct observation (Creswell, 2013). On the other hand, this means for data collection is known to be time consuming and at high risk of observer-bias. The measure used to contrast such limitation was the observation protocol abovementioned and, in this dissertation, the chain of evidence (Yin, 1993) that will be provided in the report and discussion of collected data (§Section C). Reactivity could have been another risky limitation, but given the length of time spent with the participants (5-6 months) and their assumption that the observer could not understand their native language, the issue was reduced. It is to say that the researcher was indeed not fluent neither in modern Greek nor in Dutch, but made herself familiar with the lesson materials and native-language lexicon used to talk about the topic at study. This, in turn, could have caused selectivity in the data collected, as the researcher might have missed on relevant information due to ignorance of the language. To help with this issue, observation data were triangulated with other means of investigation (see §Chp.3.1, 3.3).

3.3 INTERVIEWS

Data collection through interviews was implemented as a means to answer to the second and third research sub-questions (§Chp.1; Box 3.3), respectively about technology related dispositions and PR dimensions shown during TPCK-informed design tasks. The specific aims of data collection through interviews were:

Box 3.3 Interview data collection.

Research question to address	Sub-question 1: *How are instructional design task procedures characterized in terms of ICT integration and PR references?* Sub-questions 2a/b*: How are student teachers' dispositions toward ICT integration characterized? How are their dispositions characterized after multiple experiences with TPCK-informed design tasks?* Sub-questions 3a/b: *How are PR dimensions activated in student-teachers, when performing a TPCK informed design task? How do PR dimensions appear in student-teachers, after multiple experiences with an ICT informed design task?*
Information gathered concerning	Task procedure ease of use (instrumental); Dispositions towards teaching and learning with technologies; PR dimensions activated during the designing process.
Specific instrument	Focused interviews, semi-structured, audio-taped.
Sources	Focused interviews (Merton & Kendall, 1946; Cohen et al., 2007); Think aloud method (van Someren et al., 1994) Question examples on PR (Peterson & Treagust, 1995)
Time of implementation	Participants interviewed at the end of each design cycle (within a week from product hand in, before its evaluation). Each interview lasted an average of 30 min (first interviews) to 45 min (second interview).
People involved	Researcher (interviewing); key informants (volunteer interviewees).
Limitations encountered	Linguistic barrier; reactivity.

1. Gather evidence on the technical realization of the design task, in terms of participants' understanding of the given instructions and ease of use of the given procedure (see §Chp.3.1; 4). These data helped recognizing technical/organizational factors that could act like barriers to the very emerging of any PR manifestation, in reference to dynamics of cognitive overload[12].

2. Assemble information on participants' dispositions on technology integration in educational practices. Interviews were a core source of information to answer the related research sub-question, their data being triangulated with quantitative evidence within the mixed-method section of the case study design (Creswell, 2013).

3. Collect data on expressions of PR dimensions during the TPCK-informed design processes. This aim follows the previous one in the attempt to get to the core of the cognitive procedural model (van Someren et al., 1994) used by participants in completing their design task.

In alignment with the constructivist perspective underlying the whole study, interviews were chosen as a means to enable participants to "discuss their interpretations of the world" (Cohen et al., 2007, p. 349), being "couched in the cultural repertoires of all participants, indicating how people

[12] These data were triangulated with observations in order to widen the information basis on this issue (§Chp.3.2).

make sense of their […] world" (Barker & Johnson, 1998, p. 230). In relation to the focus on dispositions, interviews seem appropriate as they can "recognize a range of non-rational factors governing human behaviors, like emotions" (Cohen et al., 2007, p. 350). On the other hand, with respect to the reasoning processes, interviews were chosen as door to the implicit of the design problem-solving, inquiring how participants constructs solutions and justifications to these solutions (van Someren et al., 1994).

In the present research, focused interviews were implemented as specific type of qualitative means for data collection. Focused interviews are centred on interviewees' "subjective responses to a known situation in which [they have] been involved" (Cohen et al., 2007, p. 356): in this case, the design experience. As Merton and Kendal (1946) described, focused interviews' specifics are: (a) the acknowledged interviewees' involvement in a peculiar situation, which (b) has been deeply analyzed by the interviewer to (c) construct the interview protocol. In the present research these criteria were met by interviewing participants actively engaged in the TPCK-informed design task, which was analyzed in its operational characteristics through observation and documentation (see §Chp.3.1, 3.2). Information so gathered was then used to shape the questions considering the specific contextual lexicon and theoretical references implemented in the design tasks.

Going down to the specifics, the questions were framed considering:

- the first aim of data collection (realization of the task), to set a common ground for conversation building trust for a non-judgemental environment (Creswell, 2013);

- the second aim of data collection (dispositions), to investigate the same constructs as in the questionnaire and widen them (i.e., pedagogical beliefs, self-efficacy, attitudes, openness, affordances, TPCK perception – see §Chp.3.4);

- the third aim of data collection (PR), with reference to the think aloud method (van Someren et al., 1994)[13] and the examples provided in the literature for similar researches (Peterson & Treagust, 1995; Starkey, 2010), considering the theoretical PR model's dimensions (Shulman, 1987; Starkey, 2010) embedded by the specific design procedure. In this research, the think aloud technique was used first, moving from their design product to spot any evidence of pedagogical reasoning in participants' performed actions (first interview); and then, to prompt the interviewees to describe a brand new reasoning process (second interview). This, to understand more deeply both the actual student-teachers' concerns when deciding how to create

[13] The think aloud method has its origins in psychological research, as a means to access the implicit reasoning processes, especially when performing a problem-solving task (van Someren et al., 1994). It assumes a simple verbalization process, trying to avoid interpretation, and it can be used to generate a description of the reasoning process or to recognize a given one (van Someren et al., 1994).

a learning unit, and the perceived connections to their task procedures (as per main research question - §Chp.1).

In the attempt to gather in-depth information on the participants' experiences during TPCK-informed design tasks, interviews had been administered as follows. Interviewees were recruited on a voluntary basis, provided that they agreed on the following statements:

- The interview was to be carried out in English[14];
- The interview was to happen twice, at the end of each design cycle (§Chp.2.2);
- The interview was to be registered and transcribed (transcripts were subsequently sent to the interviewees for content confirmation and approval - §Chp.2.4);
- The interview's content was to be used strictly for the present research purposes, ensuring interviewees' anonymity[15].

Thus, the actual number of interviewees, within each case study, was:

1. Cyprus: 18 interviews at the end of the first design cycle[16] and 12 at the end of the second;
2. Italy: 16 interviews at the end of the first design cycle and 15[17] at the end of the second; and
3. The Netherlands: 13 interviews at the end of the first design cycle and 13 at the end of the second.

Given the different numbers both within and among the three case studies, further methodological decisions were taken. Each and every interview was considered to get a more detailed picture of the student-teacher population through time, within the single cases (§Section C[18]). On the other hand, only participants performing both interviews (at the end of both design cycles), and only 12 per case study, were considered in cross-context data analysis (§Section D).

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[14] Participants were also given a hard copy of the questions in English and in their native language. The translation was obtained through certified translators (Cyprus and The Netherlands cases) and a native-speaker researcher (Italy case). Each version was then revised and approved by other native-speaker researchers on the field accordingly.

[15] For this purpose, participants' names have been masked in the present dissertation.

[16] A nineteenth interview was eventually discarded due to a high linguistic barrier between interviewer and interviewee which made content too incomplete and ambiguous to be reliable.

[17] A sixteenth interview was eventually discarded due to a high reflexivity in the answers (Tellis, 1997) which made it not trustworthy of the real interviewee's opinions.

[18] In the Cypriot case, this decision implied a non-parametric analysis of the 12 two-time interviewees and the 6 one-time interviewees (first round), to spot any significant difference in the population of the first and second round of interviews. Such comparison, run through ENA software (Epistemic Network Analysis – Shaffer et al., 2016), showed that the two groups were not significantly different in terms of reasoning codes, for the first-round of interviews. Hence, the 12 two-times interviewees are to be considered eligible to provide still relevant data for the second-round of interviews.

While in the Cypriot case no selection was required, in the Italian and Dutch cases, the 12 cases were selected randomly among the interviewees corresponding to the criteria.

Each interview was carried out face-to-face, in one-to-one sessions lasting on average 30 min (for the first-cycle interviews) to 45 min (second-cycle interviews). Participants agreed to be audio-recorded for both sessions and video-recorded for just a portion of the second interview[19]. The transcripts resulting from both recordings were then submitted again to the key informants for further confirmation in content and consent. This was also a measure to increase construct validity of the research (§Chp.2.4). No key informant expressed disagreement in either the resulting content or the consent to use the transcripts.

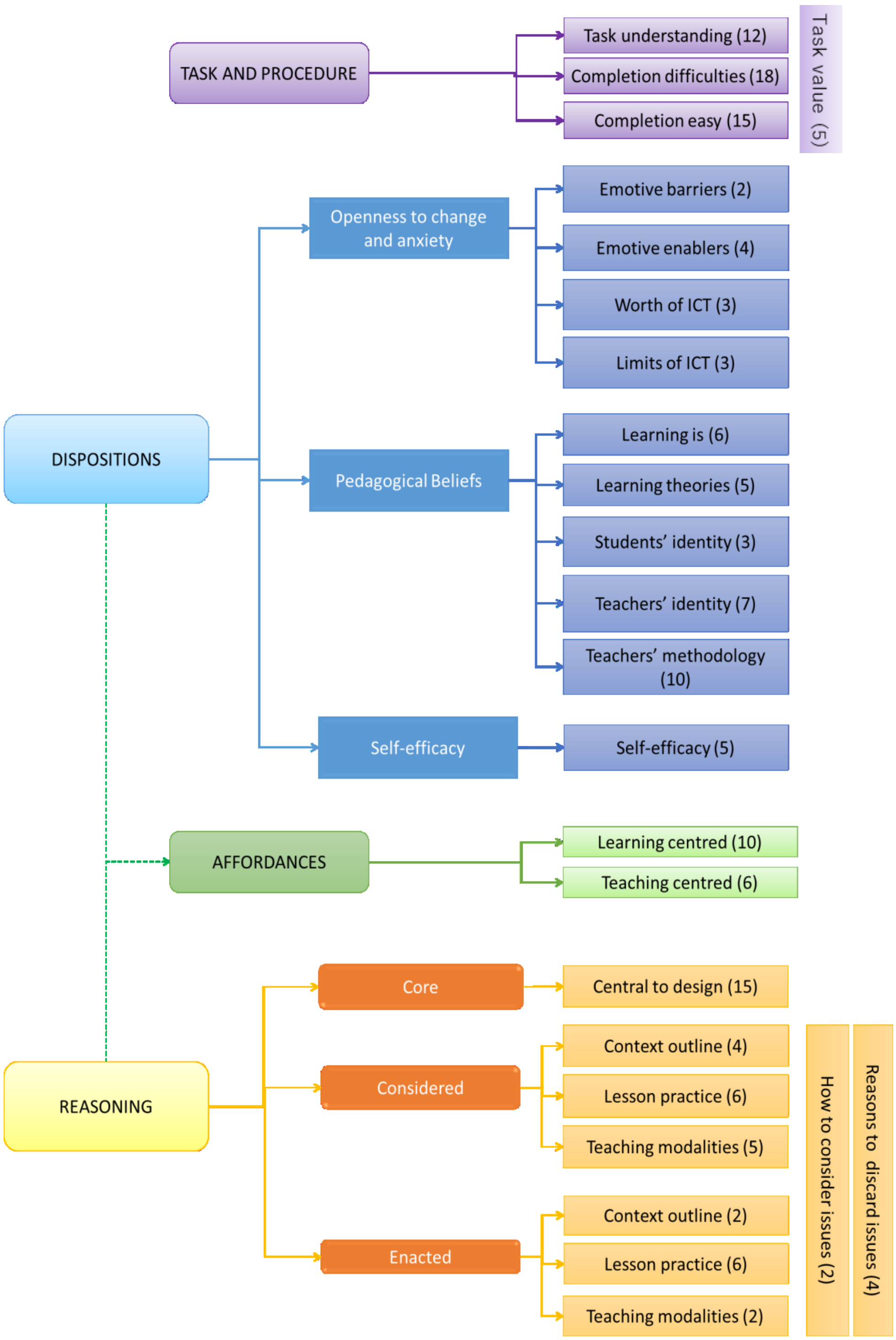
Raw data was coded in ATLAS.TI (version 8.1) for content analysis. Codes were assigned to content in a top-down and bottom-up perspective which considered (a) theoretical categories for PR (Shulman, 1987, Starkey, 2010), especially as assumed embedded in the contextual procedure, in terms of lexis (see §Chp.3.1, 3.2); (b) ICT related dispositions conceptually relatable to the ones investigated through the questionnaire (§Chp.3.4); and (c) an opening for any unexpected findings. Examples of codes can be seen in Table 3.1 and Picture 3., while the codebook is in Appendix 2.2.

Table 3.1 Examples of questions and codes for the interviews.

Research sub-question	Theme (example)	Question (example)	Code (family)	Code
1	Task ease	Could you understand the instructions on your own or did you need any extra help from the professor or the colleagues?	Task – ITE (Initial Teacher Education)	Name: *Task external help needed.* Definition: student reports the need for yet further external help in understanding guidelines, completing the task, or both. External help may include professor(s), assistant(s), fellow students, friends, literature sources and so forth.
2a/b	Self-efficacy	How do you feel about using technologies in your lessons?	Dispositions – self-efficacy	Name: *Self-efficacy ICT integration.* Definition: student comments on their confidence about actually integrating ICT in teaching practices.
3a/b	PR dimensions expression	Would you say you need to transform the concepts to make it better understandable for your students? How so?	Reasoning. Need to act upon	Name: *Subject – teachable.* Definition: Student reports need actively analyse/modify the chosen topic in relation to its teachable potential, as related to the specific context/pupils. Consider in Cyprus there is a specific item in the instructions, for this (explanation of the choice)[a].

a. Codes traced expectable instances due to contextual characteristics, even if applicable to any transcript evidence regardless of the case.

[19] Participants were video-taped when asked to create a map with the selected guidelines' items, with the only requirement of showing connections among those. In this dissertation only what was considered central/peripheral by the interviewees will be reported, although it would be interesting to go deeper into the analysis of these products in the future.



Picture 3.3 Resulting code structure. In parenthesis, the number of single codes within the family.

After the coding process, these data were treated differently according to the specific sub-question addressed and the design research section of belonging:

- Data related to the performance of the task (sub-question 1 - §Chp.1) was triangulated with documentary and observation based data to enrich the context description (Creswell, 2013) and identify any preliminary barrier to the very spark of any form of reasoning (e.g. cognitive overload).

- Data related to dispositions (sub-question 2 - §Chp.1) was merged with quantitative evidence (§Chp.3.4) in a side-by-side comparison strategy (Creswell, 2013) within the mixed methods logic.
- Data related to PR (sub-question 3 - §Chp.1) was triangulated with observations and documentation strategies (§Chp.3.1, 3.2) within the qualitative case study perspective.

In the last two circumstances, data was further analyzed with Epistemic Network Analysis strategies (ENA – Shaffer, Collier & Ruis, 2016)[20] to better visualize the findings. Such strategy is based on the assumption that patterns among elements (e.g. single dispositions, PR dimensions) are more informative than their mere occurrence. It was chosen in alignment with the theoretical bases for the present research claiming a powerful (if not yet fully explored) influence occurring in-between dispositions, knowledge bases, reasoning dimensions, to the shape of a technologically integrated behavior (See §Section A). Moving from the codes' frequencies, ENA was used to trace connections among them, making visible the strength of their co-occurrences and creating three-dimensional models where to observe a centroid (Shaffer, 2017; Shaffer et al., 2016). Said centroid was used to understand what participants perceived at the core of and what peripheral to the discussion on their design experience, in terms of dispositions and reasoning processes (§Section C).

With regards to methodological strengths and weaknesses of focused interviews, the present research tried to build on potentialities of insightful evidence collection (Yin, 1994). On the other hand, an attempt to minimize the possible interviewer's bias was made through the definition of a questioning protocol that was implemented constantly within the three contexts[21]. The very formulation of the questions was reviewed by experts in the field both in terms of content and of lexis adequacy. Nevertheless, it is to recognize the usual issues with this means of data collection, as (a) the opaqueness of the meanings to the interviewer/interviewee (Cohen et al., 2007), further influenced by the use of English in three non-English-native speaker countries; and (b) reflexivity (Tellis, 1997) of interviewees trying to please the interviewer. These issues were taken in high consideration by the researcher and were reason for rejection of two interview transcripts.

[20] The specific tool for this can be found at http://www.epistemicnetwork.org/ website.
[21] Examples of the questions are in table 3.1, while the full interview protocol can be found in Appendix 2.1.

3.4 Questionnaires

The use of a questionnaire to collect data was implemented within the mixed methods embedded design section of the present multiple case study research (§Chp.2, Box 3.4), in order to investigate the sub-question on student-teachers' dispositions towards ICT integration in education (sub-question 2 – §Chp.1). As required by the parallel convergent mixed method perspective (Creswell, 2013), findings from this quantitative strategy were merged with the relevant ones gathered through qualitative focused interviews (§Chp.3.3). The specific aims of data collection through a questionnaire were to:

Box 3.4 Questionnaire data collection.

Research question to address	Sub-questions 2a/b: *How are student teachers' dispositions toward ICT integration characterized? How are their dispositions characterized after multiple experiences with TPCK-informed design tasks?*
Information gathered concerning	Participants' demographics and academic context; Dispositions towards ICT integration in teaching and learning: self-efficacy, attitudes and perceived TPCK proficiency.
Specific instrument	Pre/post questionnaire, 7 sections, on average 16 items per section
Sources	Christensen & Knezek, 2009; Heitink et al., 2016; Messina & De Rossi, 2015; Papanastasiou & Angeli, 2008: Schmidt et al., 2009; Tondeur et al., 2016b; Yilmaz-Ozden et al., 2016.
Time of implementation	Pre-questionnaire within first week of university course lectures; Post-questionnaire within last week of university course lectures.
People involved	Researcher (administrator); key informants (whole population of enrolled student-teachers attending the session); certified translator; expert reviewers;
Limitations encountered	Length of instrument; translation versions.

1. Gather information on participants' demographics and academic context. While this goal seems not directly connected to the research sub-question, these data helped to contextualize the findings and to provide a base for cross-context comparison (Cohen et al., 2007);

2. Collect data on ICT-related dispositions, according to the theoretical constructs of beliefs, attitudes and self-efficacy (see §A-Chp.2). These concepts were investigated as acknowledged factors influencing technology-integration behaviours and powerful, yet usually tacit, component of decision-making processes (§Section A);

3. Assemble evidence on the participants' perception of TPCK proficiency (Ottenbreit-Leftwich et al., 2018: Banas & York, 2014; Kazu & Erten, 2014). This aim accounted for the specific theoretical framework for technology integration teaching knowledge at the base of the present research (§Section A).

Data collection through the questionnaire was meant to help identify the attributes of a large population (every student teacher enrolled in the university course selected as case unit - §Chp.4) in a short time (Creswell, 2013). While it was not meant to provide generalizable results, it could support analytic generalization and comparison across cases, within the bigger research design (Cohen et al., 2007 - §Chp.2.2). The questionnaire itself referred to other surveys used with similarly characterized populations and topics, in particular (Table 3.2)[22]:

Table 3.2 Questionnaire organization and sources.

Section	Investigated constructs	Type of items	Item sources (n. items)
1 N item= 7	Demographics: gender; age; year at university; previous academic relevant experience; previous teaching experience; previous technology integration in education experience; ownership of a personal device connected to the internet.	Dichotomy (gender; ownership of device); Multiple choice.	Papanastasiou & Angeli, 2008 (3) Messina & De Rossi, 2015 (2) Schmidt et al., 2009 (2)
2 N item= 19	Knowledge of use of digital technologies	5-point Likert scale *1. I don't know how to use it; 5. I can use it very well*	Messina & De Rossi, 2015 (6) Papanastasiou & Angeli, 2008 (13)
3 N item= 18	Frequency of use of digital technologies	5-point Likert scale *1. I never use it; 5. I use it every day*	Messina & De Rossi, 2015 (4) Papanastasiou & Angeli, 2008 (14)
4 N item= 21	Contextual support for ICT integration in education	5-point Likert scale *1. I strongly disagree; 5. I strongly agree*	Messina & De Rossi, 2015 (3) Papanastasiou & Angeli, 2008 (6) Schmidt et al., 2009 (1) Tondeur et al., 2016b (11)
5 N item= 37	Attitudes towards digital technologies	5-point Likert scale *1. I strongly disagree; 5. I strongly agree*	Christensen & Knezek, 2009 (16) Messina & De Rossi, 2015 (6) Papanastasiou & Angeli, 2008 (15)
6 N item= 13	Self-efficacy in integrating ICT in education	5-point Likert scale *1. I strongly disagree; 5. I strongly agree*	Heitink et al., 2016 (3) Messina & De Rossi, 2015 (4) Papanastasiou & Angeli, 2008 (4) Schmidt et al., 2009 (2)
7 N item= 26	Teaching with digital technologies (TPCK self-perception)	5-point Likert scale *1. I strongly disagree; 5. I strongly agree*	Yilmaz-Ozden et al., 2016 (26)
Total items: 141.			

- Schmidt and colleagues' (et al., 2009) survey on *pre-service teachers' knowledge of teaching and technology*. This self-assessment instrument is based within the TPACK framework, targeting pre-service teachers' perceptions of their proficiency in technology integration. Although this instrument is still today considered extremely relevant in academia (§Section A), it was here considered as original reference but mainly used in its modified versions (see below). Some of its original items' formulation was used in the questionnaire's sections related to demographics, self-efficacy and perceived academic support;

- Papanastasiou and Angeli's (2008) *survey of factors affecting teachers teaching with technology*[23]. These authors implemented said instrument with a population of Cypriot teachers, finding it reliable in psychometric properties and construct validity, also through strategies of factor analysis (Cronbach's α ranging from .78 -.90[24]). As Schmidt and colleagues' survey, this was used as overall reference in the formulation of the questionnaire,

[22] For the specific items' sources, please see Appendix 3.1.
[23] See also §A-Chp.1.3.1.
[24] A Cronbach's alpha equal or higher to .7 is commonly considered to indicate acceptable reliability, e.g. Nunnally, 1978; Nunnally & Bernstein, 1994.

but many of its items found a place in most of the questionnaire's sections, mainly the ones addressing knowledge of use of technologies, frequency of use, attitudes, self-efficacy and perceived academic support;

- Messina and De Rossi's (2015) survey, based on Schmidt and colleagues' one (2009), and administered to Italian pre-service teachers to investigate their knowledge of use and integration of technologies (Cronbach's α ranging from .85-.87). Some of its items were used in several questionnaire's sections, mainly the ones addressing knowledge of use of technologies, frequency of use, and attitudes;

- Christensen and Knezek's (2009) *questionnaire on teachers' attitudes toward computers*. This survey was implemented with both in-service and pre-service teachers to investigate how their attitudes toward technology could influence their integration practices. It was proven valid (Cronbach's α ranging from .87-.95 with pre-service teachers' population) and useful for pre-post assessments in technology integration preservice teacher programmes. Some of its items were used in the questionnaire's section related to attitudes;

- Heitink and colleagues' (et al. 2016) questionnaire on *educational beliefs, perceived knowledge and skills, and TPACK*. Their survey (Cronbach's α .91 for the TPACK core section) was aimed to identify the extent to which teachers' knowledge and beliefs influenced their technology integration in pedagogical activities and was based on Schmidt and colleagues' (2009) instrument[25]. Some of this survey's items were included in the questionnaire's sections in relation to self-efficacy measures;

- Tondeur and colleagues' (2016) self-report instrument on pre-service teachers' perception of support and training to integrate technologies in their practices. This survey was built up from the *SQD-model* (*Synthesis of Qualitative Evidence* – Tondeur et al., 2012) on teacher education programmes' strategies to support technology integration. Its psychometric properties were found satisfactory with a wide sample of pre-service teachers (Cronbach's α ranging from .83 to .98) and many of its items were used as a base for the questionnaire's section on contextual support appreciation; and

- Yilmaz-Ozden et al.'s (2016) survey on *teaching knowledge with curriculum-based technology*. Their study wanted to empirically modify Schmidt and colleagues' (2009) survey, engaging pre-service teachers as target population and observing evidence for a transformative perspective on TPCK (Angeli & Valanides, 2009). Their survey's reliability scored high

[25] Another source for this survey was a Dutch national monitoring instrument about technology use (Kennisnet, 2012).

(Cronbach's α ranging from .91 to .97) and their items were the base to the perceived TPCK proficiency section of the questionnaire.

As a result, the questionnaire administered in the present research was composed of seven sections (Table 3.2), each one with 5-point Likert scale items except the first exploring demographics information through dichotomies and multiple-choice questions[26]. It was administered face-to-face[27], twice per case unit (namely within the first and the last week of course lectures[28]) to its whole population (every student-teacher enrolled to the course and attending the session in which the questionnaire was handed out[29]).

Whereas the original sources were in English, the instrument has been translated into Greek, Italian and Dutch according to the contextual case study. While this was done in the attempt to decrease language ambiguity by asking questions in the same language as the respondents', it required additional care and time to ensure adequate construct validity in the final instrument. The Greek and Dutch versions were obtained through the translation by a certified translator, and then revised by two Greek or Dutch native-speaker researchers in the field accordingly. The Italian translation was carried out by the researcher and revised by two Italian native-speaker researchers on the field. Each of the revised versions was then tried out with a small sample of student-teachers as a pilot and thus implemented with minor modifications.

The questionnaire's reliability measures carried out both for the first and the second administrations resulted acceptable (Cronbach's α ranging from .78 to .97 – a Cronbach's alpha equal or higher to .7 is considered to indicate acceptable reliability, e.g. Nunnally, 1978). Exploratory factor analysis (EFA) on the items within single questionnaire sections (scales) was run separately in SPSS software considering extraction based on eigenvalues greater than 1, scree-plot, varimax rotation within each subscale, and amount of variance explained. The outcome factor structure was as follows (Table 3.3):

[26] For the complete instrument, see Appendix 3.2.

[27] While the administration of the questionnaire was always face-to-face, participants completed the survey on a hard copy version or online, according to the context's requirements (see §Chp.4.1-4-3).

[28] As mentioned in §Chp.3.2, the researcher was introduced to the student-teachers in her role at the beginning of the university course at study. In that occasion, consent was asked to the participants for the implementation of a questionnaire (also reported in the heading of the instrument itself). The informed consent relied on issues of beneficence (as the research is meant to improve student-teachers' education, in the long run), non-maleficence (as participants were assured their answers would not have any impact on their course grades), and anonymity of the responses (Cohen et al., 2007).

[29] For more information about the number of respondents for each case study, see §Chp.4.1-4.3.

Table 3.3 Questionnaire factors and reliability per section (EFA).

Questionnaire section	EFA Factors	Item example	Reliability pre Chronbach's α (n. items)	Reliability post Chronbach's α (n. items)
2 Knowledge of technology	Lower order digital applications and software	*(level of use) text editing software*	.84 (8)	.82 (8)
	Higher order digital applications and software	*(level of use) simulations*	.84 (8)	.89 (8)
	Common internet use	*(level of use) mailing system*	.82 (3)	.85 (3)
3 Frequency of technology use	Lower order digital applications and software	*(frequency of use) text editing software*	.78 (18)[a]	.81 (18)[a]
	Higher order digital applications and software	*(frequency of use) simulations*		
	Common internet use	*(frequency of use) mailing system*		
	Leisure uses	*(frequency of use) engage on social networks*		
4 Contextual support	Surrounding encouragement	*(agreement rate) many colleagues encourage me to integrate computers in my lessons*	.79 (8)	.78 (8)
	Equipment	*(agreement rate) technical infrastructure in my university is adequate*	.83 (4)	.84 (4)
	University's active role	*(agreement rate) in my university courses there are enough occasions for me to test different ways of using digital technology in the classroom*	.92 (9)	.89 (9)
5 Attitudes towards Technologies	Emotive Signposts		.90 (15) (overall factor)	.92 (15) (overall factor)
	Emotive Signposts: Emotive barriers	*(agreement rate) I am upset when I think of trying to use a computer.*	.87 (8)	.86 (8)
	Emotive Signposts: Emotive enablers	*(agreement rate) I feel comfortable with working with a computer.*	.82 (7)	.85 (7)
	ICT impact on teaching and learning	*(agreement rate) The computer helps teachers to teach in more effective ways.*	.90 (16)	.91 (16)
	Lack of worth of ICT	*(agreement rate) I can't think of any way that I will use computers in my career.*	.70 (5)	.73 (5)
6 Self-efficacy	Perceived self-efficacy in integrating ICT	*(agreement rate) I can design learning activities for my students, using ICT.*	.93 (10)	.90 (10)
7 TPCK	Integrating ICT in teaching practice meaningfully	*(agreement rate) I can use technology to improve what I teach, how I teach and what students learn.*	.95 (18)	.91(18)
	Knowledge of ICT (approach)	*(agreement rate) I know how to use technology to assess student work.*	.82 (8)	.90 (8)

a. The data in this section were considered as measures of access to the investigated technologies. For this reason, the factor structure was imposed by the one in the previous section (*knowledge of use*), and reliability was carried out for the whole section, while the factors analysed just with descriptive statistics as support for the ones in the *knowledge of use* section.

- **Section 2[30] – knowledge of use of technologies**. EFA on the pre-test identified 3 factors explaining 57.4% of variance. Factors align with original sources as for items included and are:
    - *Lower order technologies* (α= .84), with items related to information gathering and production applications and software: Office suite (word, excel, PowerPoint), Paint, Moviemaker, databases, tools for bibliographic research online (e.g. Scholar), platforms for remote collaboration (e.g. wiki, forums);
    - *Higher order technologies* (α= .84), including reference to digital applications and software more specific to the educational area: interactive whiteboard, multimedia

[30] Section 1 was demographics information and thus not subject to Exploratory Factor Analysis.

software (e.g. Hyperstudio), concept mapping tools (e.g. Kidspiration, C-map), electronic publishing tools (e.g. Publisher, FrontPage), programming languages, modelling and simulations (e.g. Model-it, Stagecast); and

- *Common internet use* (α= .82), regarding the use of Email systems, internet browsers (e.g. Chrome), internet search engines (e.g. Google).

EFA on the post-test still found the same 3 factors with still good reliability (α≥.82), mostly presenting the same items' composition as before[31]. For consistency reasons, pre-questionnaire factors were chosen when carrying out further statistical analyses.

- **Section 3 – frequency of technology use**. Analysed as a descriptive measure of the access to technologies, it was observed through the lens of the 3 factors of the previous section, to gather more background information on the participants' knowledge of use of technologies. When in doubt (for different items in the two sections) original sources' classification was used. Thus, the scale (α= .78) was further observed for descriptive measures about:
  - *Lower order technologies*: Office suite (word, excel, PowerPoint), Paint, Moviemaker, using educational CD; tools for bibliographic research online (e.g. Google scholar);
  - *Higher order technologies*: multimedia software (e.g. Hyperstudio), concept mapping tools (e.g. Kidspiration, C-map), electronic publishing tools (e.g. Publisher, FrontPage), programming languages, modelling and simulations (e.g. Model-it, Stagecast); platforms for remote collaboration (e.g. wiki, forum), databases;
  - *Common internet use*: email system, surfing the internet; and the additional factor
  - *Leisure use of technologies*: gaming apps (e.g. Solitaire) and social tools (e.g. Twitter).

  Reliability on the post-test slightly increased (α≥ .81) revealed weak and strong items similar to the pre-test ones. For consistency reasons, pre-questionnaire's structure was chosen when carrying out further statistical analyses.

- **Section 4 – perceived contextual support**. EFA identified 4 factors with different reliability scores. Considering the sources and theoretical references, the most sensible choice seemed the 3-factor distribution, with variance explained at 57.3%. The outcoming factors in the pre-test are:

[31] For the specific items' composition within the factors pre/post, please see Appendix 3.3.

- *Surrounding encouragement* to integrate technologies in education (α= .79), with items related to the perceived pressure in/outside academia towards using technologies for teaching and learning;
- *Equipment* (infrastructure adequacy) (α= .83), with items related to the perceived accessibility and quality of university equipment to learn/practice technology integration; and
- *University's active role* in supporting technologically integrated teaching practices (α= .92), related to the strategies implemented by academia to proactively support student-teachers in becoming technologically integrated practitioners.

EFA on the post-questionnaire revealed factors composed very differently from the entry ones. Nevertheless, measures of reliability of the pre-factors imposed on the post-questionnaire data revealed to be more than acceptable (α =.78 -.89). It was thus decided to use the pre-questionnaire factors to carry out further statistical analyses.

- **Section 5 – attitudes toward technology**. Reliability on the whole section did not come out too high (α= .65) because too many constructs were implied. EFA identified originally 8 factors, but considering original sources and practicability, eventually a 3-factors distribution was chosen explaining 45.5% of variance:
    - *Emotive signposts* (α= .90), with items related to comfort and stress in using technologies in education. As the analysis identified a clear distinction of positive versus negative items (the former being all positively related, the latter all negatively), this factor was divided in its two components so to obtain a more detailed picture of participants' emotive signposts towards technology integration:
        - *Emotive barriers* (α= .87), with items related to stress, frustration and difficulty in the approach to educational technologies; and
        - *Emotive enablers* (α= .82), with items related to comfort, ease and likelihood to include technologies in everyday practices;
    - *ICT impact on teaching and learning* (α= .90), including items concerned with the perception of technologies' influence on teaching and learning processes, as well as their worth; and
    - *Lack of worth of ICT* (α= .70), related to the assumption of technologies' inconsequentiality if not even negative impact on teaching and learning processes.

EFA on the post-questionnaire revealed factors composed quite differently from the entry ones. Nevertheless, measures of reliability of the pre-factors imposed on the post-questionnaire data revealed to be more than acceptable (α .73 - .92). It was thus decided to use the pre-questionnaire factors to carry out further statistical analyses.

- **Section 6 – self-efficacy.** EFA on the pre-questionnaire identified two factors, but reliability measures both on the whole section and on the separate factors indicated that the second factor (composed of only 3 items) was not reliable (α= .33). It was thus eliminated. The only remaining factor, explaining 49.4% of variance (α= .93), included items related to the self-assessment of the practical capability to integrate technologies for educational purposes.
  EFA on the post-questionnaire revealed the same 2-factors distribution, with the second one made up of 4 items and acceptably reliable (α= .69). For consistency reasons, and given that the reliability of the pre-questionnaire single factor was still high on the post-questionnaire data (α= .90), the original 1-factor distribution was chosen, when carrying out further statistical analyses.

- **Section 7 – TPCK proficiency**. EFA on the pre-questionnaire identified two factors composed of items almost identical to their original source, explaining 51,9% of variance:
  - *TPCK in practices* (α= .95) with items dealing with content-based, pedagogically oriented technologically integrated practices;
  - *TPCK awareness* (α= .82), with items concerning the approach to knowing ICT for educational purposes.

  EFA on the post-questionnaire revealed similar factors and inner compositions, all with good reliability (α ≥.90). For consistency reasons, pre-questionnaire factors were chosen when carrying out further statistical analyses.

Once verified the reliability of the instrument, collected data were analysed according to the research purposes. Information in sections 1- 4 (*demographics, knowledge of and access to technologies, perceived contextual support*) was inspected to gather information on the participants' characteristics and educational context, within the single case studies (see §Chp.4). Sections 5 and 6 (*attitudes towards technology and self-efficacy*) were the core data to answer the second aim of this instrument, regarding student-teachers' dispositions towards ICT integration in education, and were supported by the evidence in section 7 (*TPCK perceived proficiency*), completing the questionnaire's aims for data collection.

Descriptive statistic measures (mean $\overline{x}$, standard deviation σ, mode *Mo* and *range*) helped to offer a first idea of the participants within single case studies (§Chp.4), but then further analyses were implemented to provide a deeper description of the phenomenon at study (§Section C). Pre-post ANOVAs were carried out within single case studies, to see if any relevant changes occurred in participants' characteristics (sections 2-4) and dispositions (sections 5-7), after the engagement in multiple TPCK-informed design tasks (§Section C). Relevance in modifications pre- / post- was assessed considering 95% confidence interval and a Cohen's d. effect size threshold at .4 (Cohen, 1988). It was also considered Hattie's effect size for educational contexts with similar threshold at .4 (Hattie, 2009; see also Lenhard & Lenhard, 2016).

A two-step cluster analysis (IBM, n.d.) was performed on the totality of respondents to the pre-questionnaire across the three case studies (N_{tot} = 288)[32], considering factors in sections 5-7. This was meant to explore the possible presence of statistically relevant patterns of answers which could constitute profiles of participants shared by the three case studies. Emerging profiles were also investigated also on a single-case perspective, to understand their different incidence in the specific contexts. A discriminant function analysis was carried out on the pre-questionnaires to determine the functions/properties most strongly determining the cluster definition. These functions rely on specific factors as leading the discrimination of participants' answers among clusters. Said discriminant function analysis confirmed that 91% of the actual cluster affiliation in the pre-questionnaire respondents was justified. Trying to force the same clustering on the post-questionnaire data revealed, through the discriminant function analysis, that they would be justified only at 20%. This suggests significant changes in the respondents' answering patterns in the post-questionnaire, as corroborated also by ANOVAs. For the details about the results, please consider §Section C[33] (single case modifications in time) and §D – Chp.2 (clusters' modifications in time).

As described above, the questionnaire seemed to be a sufficiently reliable overall and valid source of information for the purposes of the present study, but its limitations cannot be denied. Starting with the ones intrinsic to the instrument, related to interpretation problems (e.g. the meaning subjectively attributed to "agree" by the respondents), reactivity issues (participants might deliberately falsify their replies to please the researcher), and central tendencies (related to the dislike of being perceived as extremists – Cohen et al., 2007). These could only be taken into

[32] This decision accounted for the disparity of numbers in the single cases, ensuring the strength of the statistical procedure. Nevertheless, it did not erase case-belonging, as it was still possible to observe in which cluster the three groups of respondents would gather most.

[33] The reader should be reminded that questionnaire data was analysed and merged with qualitative data collected through the interviews, according to the convergent parallel mixed method strategy implemented within the qualitative multiple case study design of the research (Creswell, 2013; Yin, 1994).

account by the researcher, when observing the collected information. Moreover, the very length of the instrument (141 items in total, usually completed in 15-20 min) and its multiple translations call for further revisions and piloting, if intended to be used for future researches.

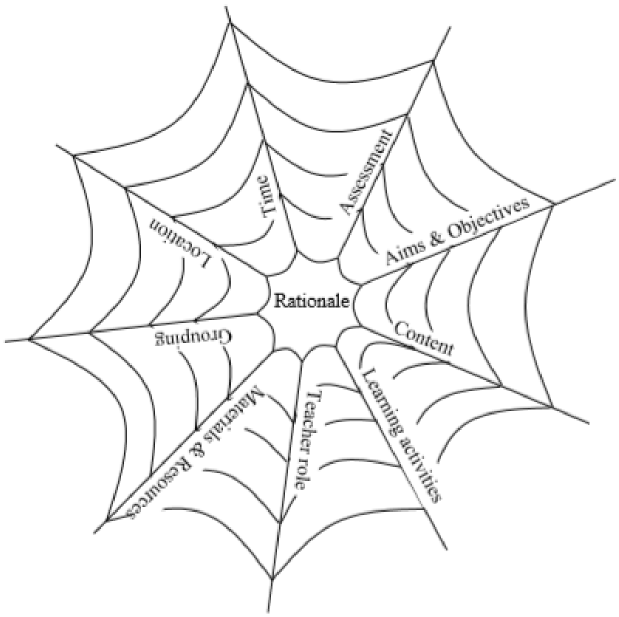
CHAPTER 4:
CASE UNIT AND PARTICIPANTS

"Culture is how people understand the meaning of things – and not just the meaning of things themselves, but the web of meanings that connect things to each other, and things to people".
(Shaffer, 2017, p. 20)

In this chapter the context for the research will be introduced starting with the considerations that identified the population of interest and hence the cases within the multiple case study. Three main cases were identified. Each one[34] will be described in its national educational systems from early childhood to higher education, and teacher education paths. A specific paragraph will also be dedicated to national educational policies for technology integration within the school system. Said description is meant to better understand both participants' educational upbringing (e.g. in schools separating/including learning diversities) and their future as educators within such educational system.

Zooming in on the participants' academic context, a short characterization of the university structure will be provided, with a focus on the educational course[35] observed in the present study. Such course will be described through van den Akker's (2003, see Picture 4.1) model for curriculum analysis, whose categories are:

1. *Rationale*: overall reasons for the course, central mission and principles;
2. *Aims and objectives*: towards which goals is the learning experience set;
3. *Content*: the subject matter of the course and its details;
4. *Learning activities*: didactic organization of the course;
5. *Teacher role*: strategies through which the educator facilitates the learning experience;
6. *Materials and resources*: pedagogical means and practical tools used;



Picture 4.1 Van den Akker's (2003, p. 6) - Curricular spider web.

7. *Grouping*: individuals and groups management;
8. *Location*: physical setting for the learning experience;

[34] Participants' groups will be listed alphabetically according to the country of residence: Cyprus, Italy and The Netherlands.
[35] For privacy reasons, individual names have been masks.

9. *Time*: chronological details for the learning experience; and
10. *Assessment*: strategies and considerations to access and state learning progression.

This description is aimed to further specify the academic context of each case and better answer to the main research question on the possible connections between educational strategies (i.e. design tasks) and student-teachers' reasoning (§Chp.1).

Finally, the case participants will be specified for their demographic characteristics: gender, age, overall familiarity with technologies, previous teaching experiences, and perception of contextual support for technology integration by their universities. The relevant data pertains to the entry questionnaire (§Chp.3.4) administered to the entire population of the students enrolled to the selected university courses.

Case Selection process

The research questions leading this study considers a student-teachers population. Such focus takes into account the great influence played by initial teacher training programmes in shaping educators' practices in the long run (Agyei & Voogt, 2011; Ertmer & Ottenbreit-Leftwich, 2010; Tondeur et al., 2017). It is when students learn how to become teachers, that the "complex bodies of knowledge and skill needed to function effectively" in that profession get exposed (Shulman, 1987, p. 4).

The criteria to identify the specific unit to our multiple-case study were (see also §Chp.2.2):

- Belonging to the European context. This accounts for the shared educational policies realized in the single countries (e.g. Europe 2020 strategy – European Commission, 2010), which could enable a multi-country observation upon some shared characteristics (i.e. the educational path to access the profession);

- Pre-service teachers' education institutions in Universities. This criterion answers the intent to observe student-teachers at a similar academic level, as granted by the Lisbon Recognition Convention (1997);

- University courses in the pre-service education curriculum, dealing with the topic of technology integration in teaching and learning. This for the intent of investigating teachers' reasoning as related to the introduction and implementation of technologies in their practices. No specification in pedagogical or content-related issue was sought, in order to maintain open the possibilities for diversified technological applications to education;

- Didactic strategies of said course which include the active participation of the enrolled student-teachers in technology-enhanced instructional design tasks. This criterion answers the intent to observe student-teachers' reasoning for technology integration when it is happening (§A-Chp.4), considering that teaching is primarily a design science (Laurillard, 2012; McKenney et al., 2015).

Given these inclusion criteria, and instances of purpose and convenience both (Stake, 2006), three cases in Europe were selected which could virtually illustrate three different parts of the European geographical conformation. The three contexts constituting the three case studies of the present research are:

1. University of Cyprus, *Instructional Technology* course for pre-primary and primary pre-service teachers (total amount of 133 attendees enrolled in Autumn 2017 – §Chp.4.1);

2. University of Padova, *Teaching Methodologies and Instructional Technologies* course for pre-primary and primary pre-service teachers (total amount of 199 attendees enrolled in Autumn 2018 – §Chp.4.2); and

3. Windesheim University of Applied Sciences, *Learning & ICT* course for pre-service teachers at any level (total amount of 13 attendees enrolled in Spring 2018 – §Chp.4.3).

This purposive sampling strategy is not aimed at a statistical generalizability of the research results (§Chp.2.4). Nevertheless, the inclusion of cases comparable on the basis of the abovementioned conceptual criteria will likely guarantee a certain level of confidence in the analytic findings (Baxter & Jack, 2008; Miles, Huberman, Saldana, 2014; Yin, 1994), for analytic generalization (Cohen et al., 2007; Robson, 2002).

As described in the methodological chapter (§Chp.2), these three groups of student-teachers were involved in the research in different ways: observed in their academic environment and structure; requested to complete an entry and exit questionnaire; and engaged in focused interviews. In particular, the questionnaire administration involved the totality of the number enrolled in the selected university course, so to get the widest information base on demographics and on dispositions to ICT integration (§Chp.3.4). On the other hand, interviews engaged only a nested sample of these three groups of student-teachers (§Chp.3.3).

As the reader might recollect (§Chp.3.3), the actual number of interviewees, within each case study and in relation to the design cycles, was:

1. Cyprus: 18 first-cycle-interviews and 12 second-cycle ones;
2. Italy: 16 first-cycle-interviews and 15 second-cycle ones; and
3. The Netherlands: 13 first-cycle -interviews and 13 second-cycle ones.

It is to highlight also that, given the difference in numbers, it was chosen to consider each and every interview to get a more detailed picture of the student-teacher population through time, within the same case (§Chp.3.3). On the other hand, only participants performing both interviews (at the end of both design cycles), and only 12 per case study, were considered in cross-context data analysis. While in the Cypriot case no selection was required, in the Italian and Dutch cases, the 12 cases were selected randomly among the interviewees corresponding to the criteria.

In the next chapters, the three case studies will be further contextualized, observed about the cultural, academic and professional environment of the student-teachers involved in the research.

4.1 CYPRIOT CASE CONTEXT

Picture 4.2 Cyprus in the world (Wikipedia, n.d./a).

Cyprus (Picture 4.2) is the first case unit here presented. It is situated in the southern part of Europe and presents a unique socio-political configuration that influences also the structure of the school system. The northern part of the island is currently under military occupation by the self-proclaimed Turkish Republic of Northern Cyprus (recognized internationally only by Turkey), and the UN forces keep a permanent buffer zone in the middle of the very capital city Nicosia, where the present research took place. The educational system described in the next paragraphs pertains to the free part of Cyprus and the few occupied schools in the north (MOEC, 2017a).

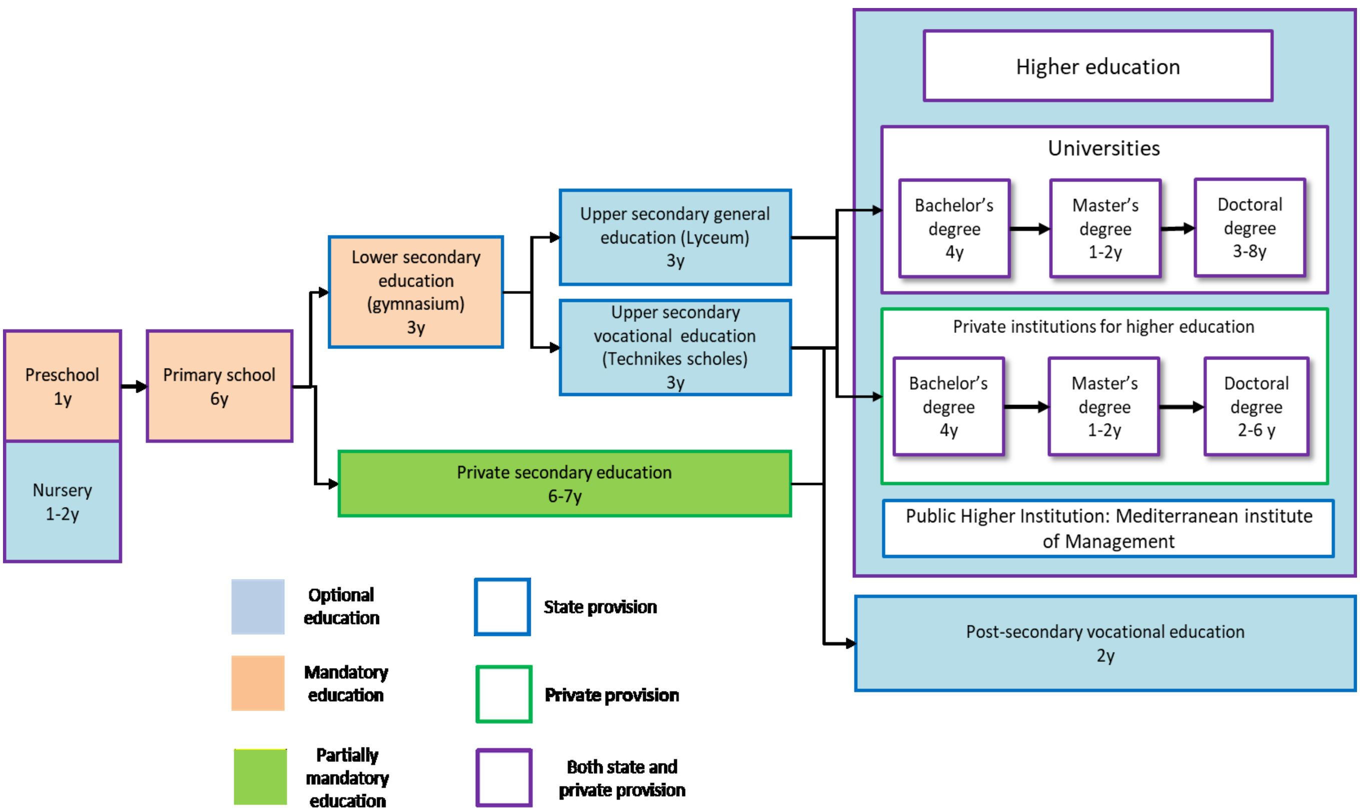
4.1.1 Educational system and path to become a teacher

The education governance in Cyprus is centralized, being controlled on different levels by the Ministry of Education and Culture (MOEC), the Education Service Commission, and the Local School Boards (Eurydice, 2017). The ministry is responsible for the identification and enforcement of education laws and policies, the national budget for education and the construction of school buildings, setting curricula, syllabuses and textbooks. For the purposes of this dissertation, particular mention deserves the Department of Primary education, within the Ministry. This Department oversees the functioning of pre-primary, primary and special education schools, organizing teaching staff and inspectorate (Eurydice, 2017). This last mansion is carried out in coordination with the mentioned Education Service commission, an independent body responsible for education staff recruitment, monitoring and dismissal. Only universities are truly autonomous, academically speaking, although the Council of the universities cares for the financial management (Eurydice, 2018a).

Compulsory education in Cyprus lasts for ten years (from 4 years and 8 months to 15years), and it is completely free for Cypriots and EU citizens when administered in public facilities, from pre-primary till higher education levels (MOEC, 2017a). The right to education is sanctioned by art. 20 of the Constitution (Constitution of Cyprus, 1960), stating that each and every individual has the right to receive and give education, albeit only in accordance with the Republic’s laws (Eurydice, 2018a). According to this document, the main objective of education is the “maximization of learning outcomes as defined in the curricula […] but also the cultivation of attitudes and skills necessary for learning and further student development" (MOEC, 2017b, p.1) and "the timeless goal of 'I know, I do not forget, I claim'" (MOEC, 2017b, p.1).

In order to have a clearer picture of Cypriot educational system, in the next paragraphs the different academic levels will be detailed in terms of governance's affiliation, typology, main aims and characteristics. Particular attention will be given to educators' requirements and qualifications, for each school level. This information is meant to better understand both participants' upbringing (e.g. the school type classification) and the school system for which they are being trained.

For an easier reading, the main information is synthetized in Table 4.1 and Picture 4.3. It is to be noted that only with the educational system of the Republic of Cyprus is considered, not the occupied schools (currently four, on the occupied northern territories- MOEC, 2017a).



Picture 4.3 Cypriot educational system.

Table 4.1 Cypriot educational system.

Name		Affiliation	Types	Pupils' age	Educational aims	Teachers' qualification	Legislative regulations
Early Childhood Education and Care (ECEC)	Pre-school	Ministry of Labour, Welfare and Social Insurance; parents' associations and the local authority	Public day nurseries (παιδο/ βρεφοκομικοί σταθμοί)	<3y	To satisfy the basic needs of the child	Nursery staff in public facilities are not required any teaching qualifications. They are social welfare personnel with civil servant status	Children Law, Chap. 352 (Περί Παιδίων Νόμος, Κεφ. 352); Children Regulations 2011 (Περί Παιδίων - Παιδοκομικοί Σταθμοί – Διάταγμα του 2011, Κ.Δ.Π. 262/2011).
		Local authority (non-for-profit basis)	Community day nurseries				
		Individuals	Private day nurseries				
	Pre-primary	Ministry of Education and Culture (approved)	Public kindergartens (νηπιαγωγεία)	3y – 5y 8months (compulsory attendance from 4y - 8 months)	To create and secure the necessary learning opportunities for children to grow a wholesome personality. To support the child's cognitive, emotional, social, moral, aesthetic and psychomotor growth in an experiential environment which enables them to recognize their capabilities and enhance their self-image	Bachelor's degree minimum - Department of Education (Τμήμα Επιστημών της Αγωγής), Faculty of Social Sciences and Education – University of Cyprus.	Decision of the Council of Ministers n. 59.824 (14/04/2004); Elementary Education Law Regulations ΚΔΠ 225/2008 and ΚΔΠ 276/2009; Laws on Private Schools and Institutes (Laws 5/1971 – 77(I)/2008).
			Community kindergartens				
			Private kindergartens				
Primary		Ministry of Education and Culture	Public primary schools	5y 8months – 11y 8 months		Bachelor's degree minimum - Department of Education (Τμήμα Επιστημών της Αγωγής), Faculty of Social Sciences and Education – University of Cyprus.	
		Individuals approved by the Ministry of Education and Culture	Private primary schools	5y 8 months – 11/12/13y 8 months			
Secondary education	Lower secondary	Ministry of Education and Culture	Gymnasio (γυμνάσιον)	11y 8 months – 14y 8 months	To enable the full development of the personality within the Cypriot system of values and achievements. It offers the instruments for a lifelong learning attitude as well as pre-professional training and specialized knowledge and skills to efficiently enter the labor market.	Bachelor's degree minimum, in the subject taught, plus nine-month pre-service training course attendance, delivered by the Department of Education (Τμήμα Επιστημών της Αγωγής), Faculty of Social Sciences and Education – University of Cyprus.	Regulations on the Operation of Public schools of 2017 (Κ.Δ.Π. 60/2017); Primary and Secondary Education (Obligatory Education and Free Education - Amendment) Law of 2004 (Νόμος του 2004 Ν. 220(I)/2004)
	Upper secondary		General education programmes (λυκεια)	14y 8 months – 17y 8 months			
			Technical and vocational programmes (Τεχνικες σχολες)				
Post-secondary not-Tertiary Education		Ministry of Education and Culture	Post-secondary Vocational education and training (MIEEK)	18+ y for 2 years	. It offers the instruments for a lifelong learning attitude as well as pre-professional training and specialized knowledge and skills to efficiently enter the labor market.	Bachelor's degree at any recognized University	Ο περί Σχολών Τριτοβάθμιας Εκπαίδευσης Νόμος του 1996 [The Tertiary Education Schools Law] (N. 67(I)/1996)
Higher (Tertiary) education		Ministry of Education and Culture	University level (πανεπιστημια) public and private	18+ y	Programmes evaluated and accredited by The Cyprus Agency of Quality Assurance and Accreditation in Higher Education	PhD qualification as minimum requirement	Ο περί του Πανεπιστημίου Κύπρου Νόμος του 1989 [The University of Cyprus Law] (N.144/1989); Law 68 (I) /1996
			Non-university level (σχολες τριτοβαθμιας εκπαιδευσης)				
Special education		Department of Primary Education	Within mainstream education	From age 3 for the duration of compulsory school	Provide pupils with all the necessary means by educators or support staff to ensure their smooth attendance in mainstream schools (whenever possible)	First degree in one of the areas of special education or first degree as a teacher of pre-/primary education and postgraduate qualification in the specialist area to teach	Elementary Education Law Regulations ΚΔΠ 225/2008 and ΚΔΠ 276/2009
			Public special education schools				

Early childhood and primary education

The pre-school system is under the remit of the Ministry of Labour, welfare and Social insurance, employing educators as civil servants in day nurseries (*παιδο/ βρεφοκομικοί σταθμοί*). These welcome pupils under the age of three in public, community and private facilities. Their first aim is to provide care and safety to the children, with limited education purposes (Eurydice, 2018). For this reason, educators working in pre-the school system are not required to hold any specific teaching qualification (Eurydice, 2018a).

Mandatory education starts when the child is at least four years and eight months (MOEC, 2017a), but kindergartens (*νηπιαγωγεία*) welcome children from three years onward. Pre-primary and primary schools are regulated by the Ministry of Education and Culture (Eurydice, 2018a). Kindergartens are available in public, community and private facilities.

Pre-primary schools figure as completion and complement to the family educative mission, supporting a wholesome growth of the child's personality through experiences to reveal their abilities and develop self-esteem (MOEC, n.d./b). National guidelines recommend creative activities through learner-centred, individualized approaches, especially in collaborative and experimental settings (MOEC, 2017b). In particular, the following aims are identified: creative thinking and expression development; maximization of pupils' potential for school success in the primary school; support in the development of personality and its attributes of taking initiative, persistence, optimism and confidence (MOEC, n.d./a, b).

Primary education comprises a six-year cycle, free and compulsory for every child of at least five years and eight months of age. There are three types of primary schools (*Δημοτικό σχολείο*): public, community and private ones (which are not free, can last up to eight years of education). In the institutional documents is found that the fundamental aim of primary education is to create and secure the necessary learning opportunities for children, regardless of age, sex, family, social background, and mental abilities, so as to enable them to develop the characteristics of a wholesome personality (MOEC, 2017a). In particular, primary education aims at:

(a) fostering a balanced emotional, cognitive and psychomotor development, even using technologies;
(b) familiarising with the school and social environment;
(c) developing positive attitudes towards learning;
(d) supporting understanding of social dynamics, resiliency, beliefs in humanitarian and cultural values; and
(e) enhancing the appreciation of beauty, in nature as in human-made endeavours, so as to become sensitized to environmental sustainability and improvement (MOEC, 2017a).

Finally, a mention to special education. Cypriot school system identifies children with special needs from the age of three, with an assessment by a multidisciplinary team of experts (MOEC, n.d./ e). It provides special need pupils with all the necessary facilitations, exemptions and means in order to successfully attend mainstream education, even with the support of education or designated staff. The Department of Primary Education is also responsible for special schools' functioning, in the rare cases it is impossible for the child to attend mainstream education (Eurydice, 2018a).

Secondary and higher education

Secondary education starts with three years of lower-secondary school (gymnasium - *γυμνάσιον*) at the pupils' age of eleven years and eight months, moving on to three years of upper secondary school offered in two different programs: general education (*λυκεια*), and technical-vocational education programmes (*τεχνικες σχολες*), which are further divided in theoretical and practical streams. The overall aims of secondary education are to enable the development of the pupils' personality in a life-long learning perspective and to offer pre-professional training and specialized knowledge necessary to successfully enter the labour market (MOEC, Department of general secondary education, n.d.).

Pupils who wish to follow an education declined to workforce preparation can later choose to attend post-secondary institutes of Vocational Education and Training (*Μεταλυκειακά Ινστιτούτα Επαγγελματικής Εκπαίδευσης Και Κατάρτισης* - MIEEK) which qualify them as professionals. Alternatively, they can choose to attend higher education in universities (*πανεπιστημια*), non-university institutions (*Σχολές Τριτοβάθμιας Εκπαίδευσης*) or Public Higher Education Institutions (e.g. the Mediterranean Institute of Management - MIM). MIM operates under the Ministry of Labour, Welfare and Social Insurance and offers programmes in Business and Public Administration, while the others offer both academic and vocational programmes of study at undergraduate and postgraduate levels, accredited by the Cyprus Agency of Quality Assurance and Accreditation in Higher Education (MOEC, 2017a).

Teacher education and training

In order to become teachers at any level past pre-school education, one has to have at least a bachelor's degree. This is obtained, for pre-primary and primary teachers, through a four-years bachelor's degree in Education publicly offered at the (Pre-)Primary School section of the

Department of Education (*Τμήμα Επιστημών της Αγωγής*), at the University of Cyprus (240 ECTS – Eurydice, 2018a). Alternatively, their title has to be recognised by the Cyprus Council of Recognition of Higher Education Qualifications (KY.S.A.T.S.) as equivalent and corresponding to those offered by said university (Cyprus Law 68 (I) /1996).

Special education teachers should hold a first degree as (pre-) primary education and a postgraduate qualification in the specialized area of desired teaching, or a first degree in one of the areas of special education: Speech therapy; Psychology; Physiotherapy; Special physical education; Music therapy; Occupational therapy; Audiology; and Teaching children with learning difficulties, emotional problems, visual or hearing impairments.

Secondary school teachers are required to hold a recognised degree at bachelor's level in the desired subject, and to attend a nine months pre-service training course (48 ECTS) delivered by the Department of Education at the University of Cyprus (Eurydice, 2018a).

Any pre-service curriculum for teachers comprises the development of specific skills for school management and administration and dealing with mixed ability/culture groups of pupils (Eurydice, 2018a). For this reason, the main areas of study, especially for (pre-)primary teacher training, are: pedagogical sciences, teaching methodology, content area courses, area specialisation (chosen between: Greek Language, Mathematics, Science; or Special Education, Art, Music, Physical education), foreign language and school experience through internship (30 ECTS – acquired with a concurrent system throughout the university years).

4.1.2 Cypriot educational policies for technology integration in education

In the last two decades, the Ministry of Education and Culture (MOEC) operated a reform of education, with an important milestone in 2011, when the new curriculum was officially defined and began to be gradually enforced at all educational levels (European Agency for Special Needs and Inclusive Education, n.d.). This reform carried the idea of shifting curriculum priorities towards a more democratic and humanistic school system which could welcome equally each and every student, and found in ICT a mean to this end. The new curriculum is based on three pillars: cohesive and sufficient content knowledge (according to "I know, I do not forget, I claim" - MOEC, 2017b, p.1), active citizenship and European-based key competences.

From 2011, the MOEC started actions to train teachers, provide better infrastructure and improve teaching methods and implement the new curricula, establishing a number of ICT teams responsible for: ICT infrastructure; Digital educational software; Educational portals; Teacher ICT initial/in-service education; School Management Systems; Internet and web-based services; ICT contracts monitoring; and ICT budget and planning (Roushias & Mardagijs, 2011). These teams should ensure that schools are adequately equipped with advanced ICT infrastructure, and teachers are adequately trained to be enabled to improve their methods thanks to ICT affordances. These actions involve every level of the educational system in Cyprus (Roushias & Mardagijs, 2011).

The Department of Primary Education operates greatly in the exploitation of modern technologies, upgrading and enriching the Primary level curriculum, recommending teachers to reshape their educational objectives with technologies and enact dynamic interactive activities with them (MOEC, n.d./a). In the (pre-) primary school curriculum ICT is not a distinct subject, but a powerful tool for teaching and learning, e.g. for the differentiation of educational processes in the development of skills like problem solving, decision making, communication and information handling (Roushias & Mardagijs, 2011). For this educational level, the MOEC formed a team of ICT advisor-consultants made up of technology-expert primary teachers who would help teachers with pedagogical and technological guidance to ICT integration in everyday practice. Pre-primary and primary schools are now equipped with 1 or 2 desktop computers in every classroom and staff room, and 10-16 units for every lab (Roushias & Mardagijs, 2011). They also are given a number of laptops depending on school size, ceiling-mounted and portable projectors, multiple printers and scanners. Certain educational software was purchased and installed in every school and staff computer in (pre-) primary education, customized to be in line with the national curriculum and to be used interdisciplinary (Roushias & Mardagijs, 2011).

The International Research Centre CARDET conducted in 2009 a large scale survey in Cypriot primary schools on ICT use (Vrasidas, 2014), finding that teachers indicated a daily ICT use for: preparing educational materials, tests and assignments (72% and 68%), or preparing lesson plans (45%). Fewer teachers reported ICT joined use with the students, accounting for ICT daily tasks focused on: play educational games (15%), collaborative and individual work in the classroom (14% and 12%), and internet use to complete a learning task (13%) (Vrasidas, 2014). These data were considered by the MOEC when identifying some measures to help teachers enact the best ICT potentialities for teaching and learning processes (Roushias & Margadijs, 2011).

At the secondary level, ICT is a course which follows the European Standards (ECDL), with notions of e-Safety, algorithms and programming (Roushias & Margadijs, 2011). ICT use as interdisciplinary tool is also encouraged, to engage students in meaningful learning experiences involving problem-solving, critical thinking, communication, creativity, collaboration and innovation (Roushias & Margadijs, 2011; MOEC, n.d./c, d). At this level the main ICT actors are ICT teachers and inspectors. The first ones are required to teach ICT as a subject and run the daily routines in their schools as network administrators, webpage designers, lab technicians. Secondary education ICT inspectors are designed by the MOEC to (1) design and update ICT curricula, (2) inspect, guide and support ICT teachers, and (3) inspect ICT labs for safety and workability standards (Roushias & Margadijs, 2011). As for the equipment, secondary schools can count on 17-20 desktop computers in every computer lab, typing classroom and subject-related labs; a number of laptops depending on school size, ceiling-mounted and portable projectors, multiple printers and scanners. In addition, there are interactive whiteboards in several mainstream classes across the country (Roushias & Margadijs, 2011).

A research carried out in 2008-2009 by the Cyprus Pedagogical Institute (CPI) about the use of ICT in the learning process revealed interesting outcomes (Cyprus Pedagogical Institute, n.d.; Roushias & Margadijs, 2011). Teachers at every level reported a need for pedagogical support to ICT use, feeling not so confident due to infrastructure limitations, curricula constraint and pressure, and the emphasis on a content-based teaching approach. Thanks to an increment of resources and projects proposed and supported by the CPI in collaboration with teachers to design lessons, this situation was reported to improve slightly in the following years (Roushias & Margadijs, 2011). Teachers became more aware of the potentialities of ICT for mixed abilities groups of students, who can be actively involved in inquiry learning, creation of complex cognitive constructs, build genuine understanding and critical and reflective thinking skills (Roushias & Margadijs, 2011).

There is no uniform or formal assessment protocol for ICT syllabus in Cypriot schools, it being carried out as part of the curriculum assessment, e.g. with tools like word processing, spread sheets, presentations, and so forth. Likewise, there is no assessment or accreditation schema for teachers' ICT competence or teacher trainers' education (Roushias & Margadijs, 2011).

4.1.3 University of Cyprus: Department of Educational Sciences

The university of Cyprus (UCY) was first established in 1989 as first public university of the island, now hosting more than 7000 attendees (about 1.300 new undergraduates each year), 1327 academic and administrative staff, and 20 000 alumni (University of Cyprus, n.d.). In its statute, UCY claims as main aims the promotion of scholarship and education through teaching and research, and enhancement of cultural, social and economic development (University of Cyprus, n.d.).

It consists of eight faculties and twenty-three departments, operating officially in Greek and Turkish, although other languages may be used in postgraduate inter-University cooperation programmes and in some Linguistic Departments (e.g. English Studies or French Studies). Admission at the University follows the students' results in the competitive *Pancyprian Examinations* organized by the MOEC, for the undergraduate level, while European and US –based criteria for academic institutions admission are followed at postgraduate level (University of Cyprus, n.d.).

Zooming in on the Department of Educational Science, the mission (*rationale*) reported on the main website reads "to contribute to the satisfaction of the national, social, cultural and developmental needs" (Kyriakides, 2019) through the:

a. Production and dissemination of knowledge in Educational sciences;
b. Identification, study and research of educational problems;
c. Training of the educative staff needed at Pre-primary and Primary Education Schools;
d. Training of candidates for Secondary education;
e. Participation to in-service development courses; and
f. Development and provision of postgraduate programs for future leaders in the field (Kyriakides, 2019).

To fulfill these objectives, the Department offers (Pre-) Primary education programs; pedagogical training programs for mechanical and technical teacher candidates; training programs in various fields for teachers of (pre-)primary, secondary and technical education; and several postgraduate programs. Overall, there are about 2000 candidates each year for the Teacher Education program alone, among which only 150 are admitted per year (Kyriakides, 2019).

The specific context of the present research involved the *Instructional Technology* course (*Εκπαιδευτική Τεχνολογία*) within the curricula for both pre-primary and primary teachers, hosted by Dr. C.A., whose educational background is in Information and Instructional Technology.

Following van den Akker's (2003) model for curriculum analysis, the main features of this course[1] appear as follows:

1. *Rationale:* the course moves from the consideration that technology is a non-neutral, powerful means for achieving learning goals. Nevertheless, technology has limited capabilities to support learning, if seen only as mere appendage to it, used for a simple technological upgrading. "Only considering technology as an important learning and cognitive tool [with] added learning value

[1] The information hereafter reported was gathered through participant observation during the implementation of said course and thanks to the document analysis of the course materials, available to the researcher in hard copy. The main reference for this paragraph is Angeli (2017a), in Appendix 1.1a. The course structure and characteristics were the same for both the one addressed to pre-primary student teachers and primary student-teachers. Although the research included the investigation of both courses, they will be described just one time.

in selected teaching situations justifies both the efforts and the costs associated with the integration of new technologies into the learning process" (Angeli, 2017a, p. 1). Central to the course is the mission to make future teachers fully aware of technologies as learning and cognitive tools which facilitate the organization and representation of content-related cognitive structures.

2. *Aims & objectives* are twofold: on one side the course wants to provide future teachers with technical skills to use technological tools, and on the other side it wants to enable them to design and create interactive technology-enhanced learning environments. These aims consider the development of students' TPCK as transformative body of knowledge, necessary to teachers who want to successfully realize the added value of technologies' potential in educational settings (Angeli & Valanides, 2009).

3. *Content*: the course focuses on several technologies as cognitive tools, among which concept mapping tools, microcosms, simulations, modelling tools, digital narrative tools, educational robotics, games and quizzes, multimedia and hypermedia. Furthermore, the contributions of digital technology to teaching and learning is addressed, as well as notions of TPCK, (technology-enhanced) instructional design, methodologies for technology-enhanced teaching, learning theories and teaching approaches, and their alignment to teaching approaches with technology.

4. *Learning activities*: the course comprised 13 weeks of lecture lessons flanked by weekly workshop lessons in the computer lab. Course and workshop attendance were mandatory.

5. *Teacher role*: the course's Professor personally delivered all the lectures and collaborated closely with the Lab Teacher for the definition and realization of the workshop activities. Both were active on the University Platform to supervise forums and online-based activities, and were available for weekly office hours at the University.

6. *Materials and resources*: the course syllabus mentions several hard copy materials to support content learning, mainly peer reviewed international articles and book chapters. Additionally, browsing international Educational Research journals was suggested, as well as the purchase of some software (WeVideo, Kidspiration, Lego WeDo).

7. *Grouping*: students were involved in plenary session work (during lectures), group and individual work (in the exploitation of the different software and design tasks), and online participation to e-TPCK platform (Christodoulou, n.d.) and forums on the university platform.

8. *Location*: the course took place in the University buildings in the free part of Nicosia (CY). Lectures were set in classrooms with fixed and non-fixed seats (respectively for primary and pre-primary courses' lessons), equipped with a ceiling-mounted projector, a desktop computer and closed Wi-Fi connection (not always functioning). Workshops were set in a computer lab, equipped with 30 desktop computers, non-fixed seats, one ceiling-mounted projector and closed Wi-Fi connection.

9. *Time:* the thirteen course weeks took place in autumn 2017, from September to December. Weekly lectures were carried out for a total of three hours per week, while weekly workshops added up to a total of one hour and a half per week[2].

10. *Assessment*: considering the different teaching and learning modalities, students' assessment was carried out on their technology-enhanced design products (20+20%), participation on the e-TPCK platform (20%) and a final written examination on theoretical notions and practical possible realizations of technological potentialities to teaching and learning (40%).

Given this background information on the specific course observed, the next paragraphs will zoom in on the characteristics of the students attending the course, as active participants to the research.

4.1.4 Selected participants

Participants to the present research were future teachers enrolled in the *Instructional Technology* course (*Εκπαιδευτική Τεχνολογία* - §Chp.4.1.3) both in the pre-primary and primary curriculum. The total amount of students enrolled to this course in the academic year 2017/2018 was 133. It should be noted that this was the only mandatory course during their second year in the four-year bachelor's degree in (Pre-) Primary education. The following participants' description derives from the data collected through (a) participant observation of the researcher (§Chp.3.2), and (b) the pre-questionnaire (§Chp.3.4) administered in presence to the entire student population attending the course on its first week, in September 2017. The collected pre-questionnaires amount to 113, equally distributed between pre-primary and primary future teachers.

[2] The reported timeframe refers to the single course within either the pre-primary or primary curriculum. The researcher observed and investigated both courses. Workshops welcomed groups of up to 30 students, so multiple sessions per week were activated. The researcher observed every one of them.

Participants' features here described were addressed in questionnaire's section 1 (*demographics*), 2 (*knowledge of use of technologies*), 3 (*frequency of personal use of technologies*) and 6 (*perceived contextual support to technology integration in education*).

Among the 113 respondents, 89% were female and only 11% male, both genders gathering mainly in the lower age range of 17-22 years old (respectively 77% of females and 7% of males – see Figure 4.1). The majority of these student-teachers was attending their second year at university (83%), with the exception of a 9% at their third year. Furthermore, 93% of respondents report being at their first university-level course on ICT integration in education, while among the remaining 7%, mainly students attending the third or fourth year at University are to be found. These data seem to agree with the University Program structure for Teacher education (§Chp.4.1.3): the *Instructional Technology* course is expected to be attended by second year students (likely to be young) and it is mandatory, so there is the possibility to have older students re-taking it if previously failed. The huge gender disparity could account for a different appeal of the teaching profession, especially at lower grades, for Cypriot boys and girls, as documented for the European context (OECD, 2018).

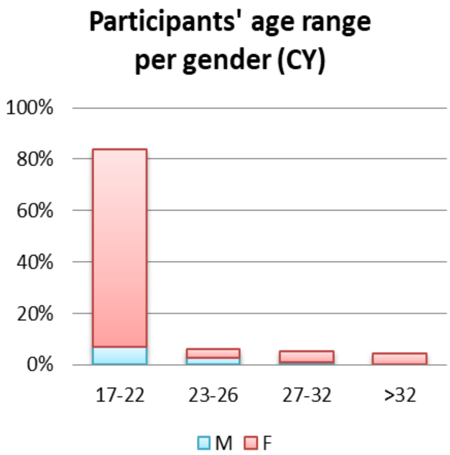


Figure 4.1 Participants' demographics – age and gender (CY).

When asked if they had any teaching experience in formal or informal education (Figure 4.2), 81% of the respondants reported none, while among the 19% remaining the highest answer readed *other* (8%), commented with examples of baby-sitting, peer tutoring to fellow students or private lessons to younger students. Among the respondents claiming some form of teaching experience, the majority (74%) reported just a seldom use of technology in their practice (against the 10 experiencing technology in every practice and 16% in most of them). Regardless of their actual experiences with technologies in education, every participant but one reported to own at least one personal device (desktop computer, laptop or iPad) connected to the internet.

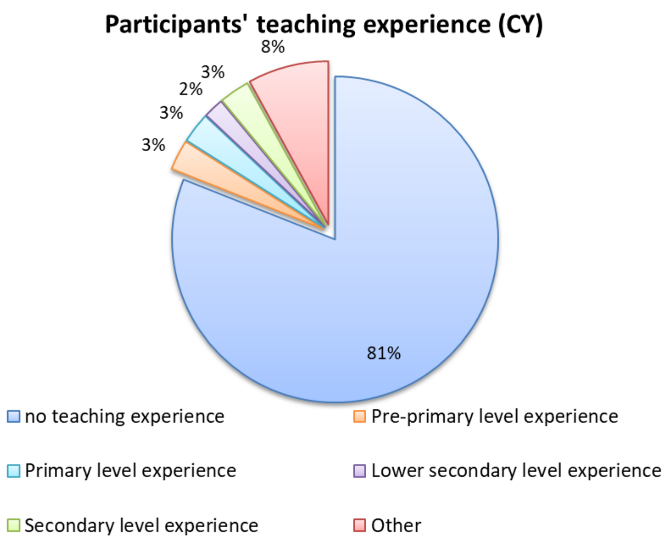


Figure 4.2 Participants' demographics - Teaching experience (CY).

Participants' familiarity with technologies was surveyed in terms of technical skills and frequency of use of those technologies. The reader should be reminded that the frequency measure is inevitably influenced by access to the tools, which varies among the three cases implied in the research (see §Chp.3.4).

As explained in the methodological chapter (§Chp.3.4), the *knowledge of use of technologies* section of the questionnaire was analyzed according to three factors:

1. lower order digital applications and software (α= .82), e.g. Office suite, databases, online collaboration platforms;

2. higher order digital applications and software (α= .89), e.g. concept mapping tools, programming languages, simulations;

3. common internet use (α= .85), e.g. email system and internet browsing.

As for the access, *frequency of use of technologies* was analyzed according to these same factors, plus the reference to gaming and social tools uses.

Observing the responses of Cypriot student-teachers entering the course (Figure 4.3), it shows an average reported knowledge of use of *lower order technologies* ($\bar{x}$=3.4 over 5[3], σ=0.6), with an associated low frequency in their use ($\bar{x}$=2.8, σ=0.6). An even lower familiarity is reported for *higher order technologies* ($\bar{x}$=1.7, σ=0.5; frequency $\bar{x}$=1.4, σ=0.4), the ones more specialized for educational contexts. To the contrary, Cypriot participants rated a high score on the use of *internet-based technologies* ($\bar{x}$=4.6, σ=0.6), supported by a similarly high frequency of their use ($\bar{x}$=4.5, σ=0.5).

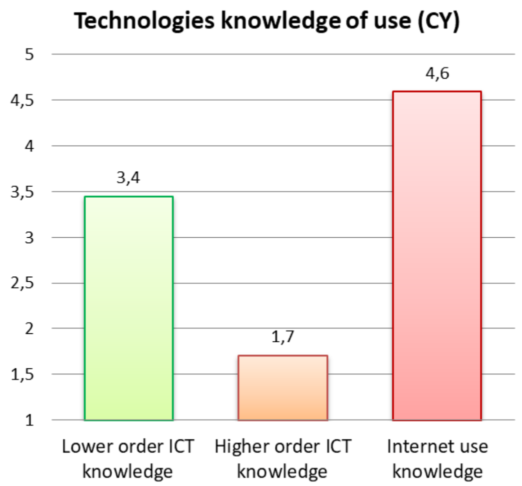


Figure 4.3 Participants' demographics - knowledge of technology use, means (CY).

A brief mention of the respondents' rate of their frequency of technology use for *leisure* purposes, as gaming or social networking: the mean was $\bar{x}$=3.5 (σ=0.7) indicating just a slightly-above average level of interest (and/or maybe access) to these technological affordances, not really expectable from a generation born in the early 2000s (Eurostat, 2017).

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[3] As the reader might recollect, data refer to a 5 point Likert scale (§ Chp.3.4).

Finally, some details on the participants' perception of support from their social and academic context, regarding ICT integration in education. Again, with reference to §Chp.3.4, the questionnaire's section of *contextual support* was analyzed through 3 factors:

1. *surrounding encouragement* (α= .79), e.g. perceiving inputs from dear ones, fellow students or other teachers to integrate technologies in everyday practice;

2. *equipment* (α= .83), e.g. observing the adequacy of university and schools' infrastructure to enable technology integration;

3. *university's active role* in supporting the students (α= .92), e.g. recognizing didactic strategies to actively show, discuss, experiment and support technology integration practices.

Cypriot participants answered similarly on all three factors: just about or slightly above the middle score (Figure 4.4). Considering that these are student – teachers' perceptions at the beginning of the educational course for technology integration, by their own assertion the first ever attended on the topic, such answers seem to set a fertile ground for improvement.

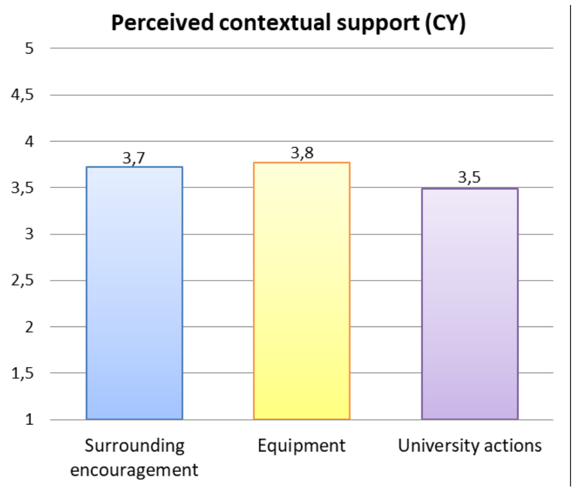


Figure 4.4 Participants' demographics - perceived contextual support means (CY).

The data just presented are meant to help understanding the participants' characteristics at the beginning of the academic course observed. They would suggest that no strong barriers were perceived when it came to access different kinds of technology or be supported by the context/university to do so. The initial overall lack of teaching experience, associated with a low knowledge of educational technologies could help within the present research in understanding the eventual impact of the academic course for technology integration in education, on pre-service teachers.

4.2 Italian Case context

Picture 4.4 Italy in the world (Wikipedia, n.d./b).

Italy (Picture 4.4) is the second case study identified for the present study, situated in the central part of Europe.

4.2.1 Educational system and path to become a teacher

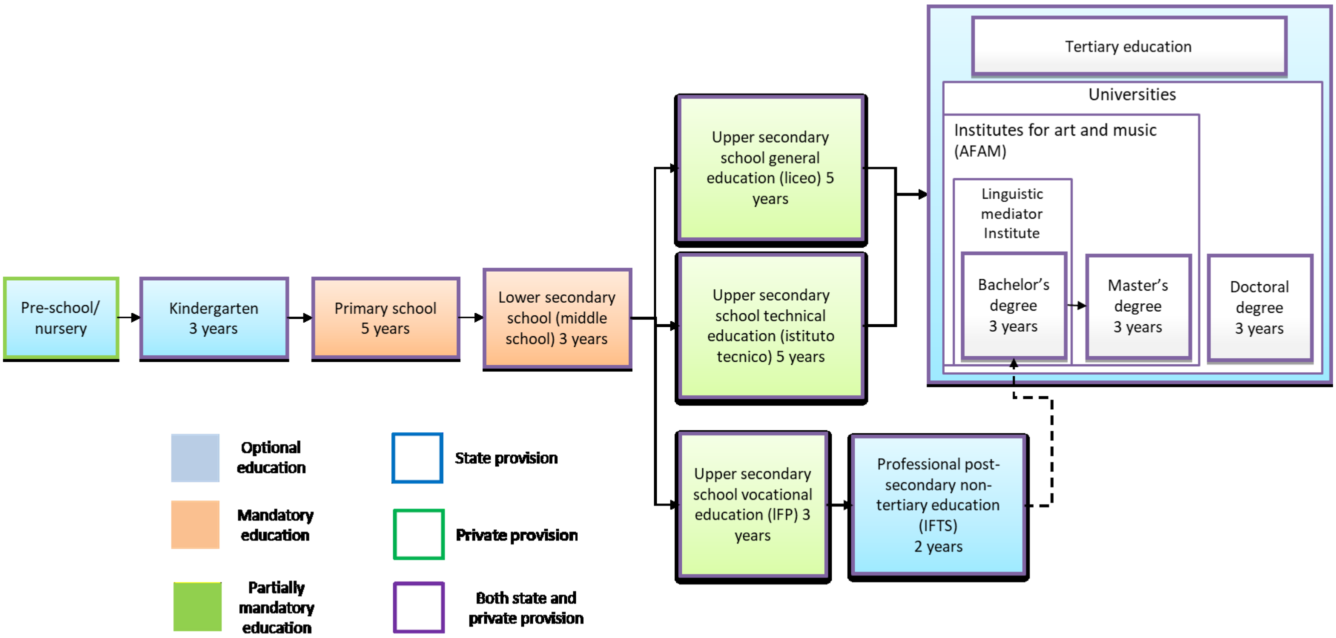
The Italian education system is decentralised, organized according to the principles of subsidiarity and autonomy of institutions (Eurydice, 2018b). The Ministry of Education, University and Research (MIUR) is responsible for the overall administration of education. Schools have a high degree of autonomy in defining curricula and teachers' organization (MIUR Law 537/1993; MIUR Law 107/2015). Universities and High Level Arts And Music Education Institutes (AFAM) have statutory, regulatory, organizational and teaching autonomy (Eurydice, 2018b).

The right to education is sanctioned in the Italian Constitution (e.g. art. 33, 34), where it is declared that the State has the duty to provide access to education to every single person in the country (Italian Constitution, 1947). Hence, the school system in Italy is mainly public, although private subjects and associations can establish education institutes, which can be either recognized by the state (*scuole paritarie*) or merely private schools (*scuole private*). The latter ones cannot issue qualifications, and should their pupils want to attend mainstream education at any point, they are required to sit for specific exams to certify the expected competences for the relevant school grade (Eurydice, 2018b).

Compulsory education lasts 10 years (pupils from 6 to 16) and is free for minors from both EU and non-EU countries. The national inclusion policy extends mainstream education to pupils with disabilities and/or social and economic disadvantages. The state guarantees measures for teaching personalization and didactic flexibility.

In order to have a clearer picture of Italian educational system, in the next paragraphs the different academic levels will be detailed in terms of governance's affiliation, typology, main aims and characteristics. Particular attention will be given to educators' requirements and qualifications, for each school level.

This information is meant to better understand both participants' upbringing (e.g. the school level classification) and the school system for which they are being trained. For an easier reading, the main information is been synthetized in Table 4.2 and Picture 4.5.



Picture 4.5 Italian educational system.

Table 4.2 Italian educational system.

Name		Affiliation	Types	Pupils' age	Educational aims	Teachers' qualification	Legislative regulations
Early Childhood Education and Care (ECEC – not compulsory)	Pre-school	Municipalities, private associations	Municipal nurseries (*nidi d'infanzia comunali*)	<3y	To satisfy the basic needs of the child	Teachers are not required teaching qualifications, they can be educators with any level of specialization	Law n. 1044/1971
			Private nurseries (*nidi d'infanzia privati*)				
	Pre-primary	Ministry of Education, University and Research (MIUR)	Public kindergartens (*scuole dell'infanzia statali*)	3 – 6y	To promote the development of children's identity, autonomy, competence and citizenship affiliation; Harmonious and comprehensive development of the child in accordance with the Italian Constitution and European culture principles, to be achieved through the promotion of knowledge, respect of individual diversity and active engagement of the community. Provide pupils with fundamental knowledge and skills to develop basic cultural competence	Master's degree qualification acquired through a specific single-cycle university programme in Educational Sciences	Ministerial Decree 254/2012 Decree of the President of the Republic 81, 89/2009 Law n169, 30/10/2008 European recommendation 18/12/2006 Law n27, 3/02/2006
		Municipalities, private associations	Private/recognized kindergartens (*scuole dell'infanzia private/paritarie*)				
First cycle of education (compulsory)	Primary	Ministry of Education, University and Research (MIUR)	Public primary schools (*scuole primarie statali*)	6 – 11y			
		Municipalities, private associations	Private/ recognized primary schools (*scuole primarie private/paritarie*)				
	Lower secondary	Ministry of Education, University and Research (MIUR)	First level secondary school (*Scuola secondaria di primo grado*)	11 – 14y	To foster the ability for autonomous study and attitudes towards social interaction Supporting knowledge and skills development to enable pupils to continue their education	Masters' degree qualification in the subject to be taught, plus teaching qualification acquired through one-year traineeship (TFA)/ two-year traineeship and professional development (SSIS)/ pass a national exam (legislation currently being reformed)	Law n. 53, 28/03/2008 Ministerial Decree n.254, 16/11/2012 Ministerial Decree 31/07/2007 Decree of the President of the Republic 87,88/2010
Second cycle of education (partially compulsory)	Upper secondary	Ministry of Education, University and Research (MIUR)	General education schools (*licei*)	14 – 19y	To prepare students to higher-level studies, provide with competence and knowledge and cultural/methodological instruments for developing their own critical and planning attitude		
			Technical schools (*istituti tecnici*)		To provide students with a strong scientific and technological background in the economic/technological professional sector		
		Regional provision	Vocational institutes (IFP)	14 – 17/18y	Strong technical and vocational perspective to prepare for the services, industry and handicraft sectors		
	Post-secondary not-tertiary Education	Regional provision	Higher technical education and training system (IFTS)	17/18y – 19y	To develop professional specializations for the labour market, in the areas of services and productive sectors		DPCM 25/01/2008 Decree of the President of the Republic 87,88/2010
Higher (Tertiary) education		Ministry of Education, University and Research (MIUR)	University level (*università*) public and private	18y+ for 3+2 years	To continue education in higher academia and specialize professional skills.	No specific initial training or continuing professional development activities It is required the national scientific qualification based on titles and publications and assigned by single universities	Law n128, 8/11/2013 Law n240, 30/12/2010 Law n169, 30/10/2008 Inter-ministerial Decree 7/09/2011
			High level arts, music and dance education institutes (*AFAM*)				
			Higher schools for language mediators (*SSML*)	18y+ for 3y			
		Regional provision	Higher technical institutes (*ITS*)	18y+ for 2y			
Special education		Ministry of Education, University and Research (MIUR)	Within mainstream education	Any school level	Follows the education level aims	Teachers possess the qualifications required for the germane education level, plus a university level specialisation in teaching special need children	Law n.170, 8/10/2010

Early childhood and first cycle of education

The pre-school system is under the remit of municipalities, with a high number of private associations offering services on this education level, employing educators in quality of civil servants. Nurseries (*nidi d'infanzia*) welcome pupils under the age of three in public and (recognized) private facilities. Their first aim is to provide care and safety to the children, with limited education purposes (Eurydice, 2018b; Italian law n. 1044/1971). Nevertheless, educators working in pre-the school system are required to hold university level qualifications as early childhood educators (DLgs 65/2017).

The earliest enrolment in a pre-primary school can happen at 24 months with the "spring sections" (*sezioni primavera*) within kindergarten schools (*scuole dell'infanzia*) (Eurydice, 2018b), which usually welcome children from the age of three to the age of six in public and (recognized) private facilities. This school level, as the following ones in the first cycle of education, falls under the remit of the Ministry of Education (MIUR). Kindergartens' education aims are sanctioned by the *National guidelines for the curriculum of pre-primary education and the first cycle of education* (Ministerial Decree 254/2012). Specifically, pre-primary schools should promote the development to children's identity, autonomy and competences, initiating them to citizenship through academic experiences close to out-of-school children's reality and active collaborations with the whole community (Ministerial Decree 254/2012).

As anticipated, mandatory education starts when the child is six years old (or turns six by the 30th April of the relevant academic year), set at primary schools available in public, private and recognized forms. It is not unusual for kindergartens, primary schools and lower secondary schools to be attached in a single school complex (comprehensive institute – *istituto comprensivo)*, managed by a single school manager, so that a child could benefit from a longitudinal perspective by his/her teachers all through the mandatory education. In particular, primary and lower secondary levels form the "first cycle of education", comprising the first 8 of the 10 compulsory academic years (Eurydice, 2018b). Still operating within the National guidelines above mentioned, primary education specific purpose is to enable pupils to acquire the fundamental skills and knowledge to develop basic cultural competence (Ministerial Decree 254/2012; Eurydice, 2018b).

Lower secondary education is offered in First Level Secondary Schools (*scuole secondaria di primo grado*). It is a compulsory education level lasting for three years and welcoming pupils aged 11 to 14 in public and (recognized) private facilities. Within the National guidelines (Ministerial Decree 254/2012), this level's specific purpose is to foster pupils' abilities to study autonomously and strengthen positive attitudes towards social interaction, organizing and increasing knowledge and skills as instruments for future education and training.

Finally, a mention to special education. Italian school system tries to identify children with special needs from the earliest age possible, with an assessment usually carried out by a multidisciplinary team of experts (i.e. teachers/educators, social services, clinical doctors, psychologists and so forth.) always with particular consideration of the family (Law 517/1977). The request for investigation towards a special need certification can be brought up by any of the people involved in the child's early years of life: from school staff to paediatricians, to the parents themselves (Law 104/1992; Law 170/2010). These certifications ensure that pupils are offered compensative or integrative means in their academic career always within the mainstream education, and are revised periodically to better adapt to the child's development.

Second cycle of education and higher education

When the child is 14 years of age, he/she has to join for at least two years the secondary level of education, so to complete the mandatory years. This can happen at any of the state or regional institutions. State institutions include general upper secondary schools (*licei*), and technical and vocational institutes (*istituti tecnici e professionali*) (Eurydice, 2018b). The first ones last five years and are aimed at preparing students both to higher education and the labour world. They provide pupils with competences and knowledge seen as cultural instruments for critical thinking and planning attitudes (Eurydice, 2018b). Technical and vocational institutes have the objective of developing students' scientific and technological background in the economic and technological professional sectors, with specializations in industry and handicraft areas. Pupils can choose any type of secondary school according to their personal preference and attitudes, considering the schools' curricula and professionalizing potentials. Every secondary school ends with a national exam on core subjects, upon which students are given a certificate that allows access to higher education at university, AFAM and SSML institutes (see paragraphs below).

Alternative to state institutions for secondary education, regions are responsible for Regional Vocational Education and Training Programmes (*istruzione e dormazione professionale IFP*), lasting three to four years up to the completion of compulsory education. This path has a specific orientation to professional preparation and does not enable direct access to higher education, but to post-secondary not-tertiary education courses offered within Higher Technical Education and Training Institutes (IFTS). These are aimed at specializing professional figures to meet the requirements of the public and private sectors of the labour market.

Pupils who wish to continue their education after the completion of the secondary level can choose among different possibilities in higher education: universities and polytechnics; High Level

Arts, Music and Dance Education Institutes (*AFAM*); Higher Schools for Language Mediators (*SSML*); and Higher Technical Institutes (*ITS*) (Eurydice, 2018b). Generally, the secondary school diploma grants access to any of these.

Teacher education and training

Teachers of primary and pre-primary education levels need to have a Master's degrees in Primary Education Sciences programmes (*Scienze della Formazione Primaria* – 300 ECTS). They are generalists and figure as civil servants with a private contract (Eurydice, 2018b). Admission requires the possession of the upper secondary leaving State exam or any other equivalent qualification obtained abroad (Eurydice, 2018b). In addition to the required qualification, students must also pass an entry test: admission to courses is limited and the Ministry of education establishes yearly the number of availabilities based on the need of teaching staff in State schools, as calculated at regional levels (Eurydice, 2018b).

Primary Education programmes comprise courses in general pedagogical and methodological subjects (276 ECTS) and specific training sessions with field internships (24 ECTS – concurrent system). They also include the acquisition of linguistic competences in English or other foreign language at a B1 level; the acquisition digital competences, especially about using multimedia languages for representing and communicating knowledge, and using digital contents, simulated environments and virtual labs (Eurydice, 2018b). The universities are also sensitive to the acquisition of didactic competences suitable to favour the integration of special needs pupils in mainstream education, organizing both specialized programmes for special needs teachers and single courses within any pre-service teaching program (Eurydice, 2018b). Teachers at (pre-) primary level are generalists, and the ones willing to work specifically as special need teachers may obtain a specialist license (60 ECTS + 12 ECTS traineeship), released by universities at the end of a master's degree.

To teach at lower and upper secondary level, teachers need a minimum of a master's degree as discipline specialist, and a specific post-second-cycle teaching qualification acquired through one or two years of traineeship (TFA, SSIS) or the pass of a national exam and a subsequent three years-probation period. At the moment, the education, qualification and recruitment processes of teachers of this school level onward are under revision from the Italian government (Eurydice, 2018b).

4.2.2 Italian educational policies for technology integration in education

The most recent and relevant national policy for technology integration in school practices is to be found in the *Digital Schools National Plan (Piano Nazionale Scuola Digitale* – PNSD) based on MIUR Law 107/2015. Merging into that are other projects like *Azione LIM* (started in 2008), aimed at a capillary diffusion of interactive whiteboards (IWB) in Italian state schools (arriving at 35114 IWBs in the entire country – PNSD, 2015); and *Azione Cl@ssi 2.0* (started in 2009) with the aim of re-designing learning environments through the physical integration of technologies (PNSD, 2015). Along with a strong economic investment on hardware acquisition, Italy supported also the regularization of Wi-Fi connection within all levels of schools, with statistics that in 2014-2015 reported around 70% of schools adequately equipped to "support a digitally integrated teaching practice" (PNSD 2015, p. 17).

The PNSD (2015) works in a perspective of cultural, social, and institutional innovation focusing on the digital means a powerful educational tool. Its main areas are:

- Access and instruments: equipping each and every school with internet connection and suitable hardware;
- Learning spaces: creating digitally enhanced workshops in an active learning perspective (e.g. Bring Your Own Device experiences), adapting schools' architecture;
- Digital identity: associating a unique digital profile to each person working in the school system or studying in it;
- Digital administration: digitalizing school administration and enhance digitally based school-families communications, opening schools' data and services to citizens and companies;
- Digital competences for learners: identifying and developing pupils' digital competences, educating teachers as facilitators of innovative teaching practices, and reforming curricula;
- Digital contents: enhancing the use and share of valuable digital contents, opening to the labour market sector;
- Teacher education: supporting school staff education on digital competences, defining standards for teaching innovation to be addressed at pre-service and in-service training levels (PNSD, 2015).

Within this Plan, a new professional figure emerges, called digital animator (*animatore digitale*). They are in-service teachers specifically trained (DM 435/2015) to cover a strategic role in the diffusion of digital innovation practices at school.

4.2.3 University of Padova: Philosophy, Sociology, Education and Applied Psychology Department

The University of studies of Padua (*Università degli studi di Padova - UniPd*) was first founded in 1222 providing course studies related initially to law, then to the other disciplines, always with a bottom up organization that considered primarily students' academic needs (e.g. the university's Rector would be elected among the students). Today, it counts almost 60 000 students enrolled (about 13 336 newly enrolled every year – UniPd, n.d.), and academic and administrative staff amounts at 5170 (UniPd, n.d.). Its statute claims that the main aim of the University is to promote and organize higher education and scientific research, respecting teaching and scientific freedom, as well as encouraging knowledge dissemination in the wider community (UniPd, n.d.). It comprises 8 Athenaeums schools[1], which coordinate and are further declined in 32 Departments directly responsible for under graduate and graduated courses. The Department of Philosophy, Sociology, Education and Applied Psychology aims to foster "interdisciplinary analyses of human experience in social contexts" (UniPd FISPPA, n.d., p.1). It comprises 6 Bachelor's degrees and 5 Master's degree courses, 9 advanced traineeship programmes and 4 PhD programmes.

The Pre-primary and Primary teachers' education program, called Primary Education Sciences (*Scienze della formazione primaria*) is a 5-years combined Bachelor and Master's degree program and counts 200-300[2] new students every year (admission is regulated by an entry test). The main aim of the Program is to provide advanced education on school disciplines, psycho-pedagogical subjects, teaching- related and methodological issues, social and organizational competences for teaching, and learning processes management (UniPd FISPPA, n.d.). Students graduating from this program can teach at both pre-primary and primary school level and are certified with B1 English skills and basic informatics competences.

[1] These are: Agriculture and Veterinary Medicine; Economics and Political Sciences; Law; Engineering; Medicine and Surgery; Psychology; Sciences; Human, Social and Cultural Heritage sciences (*Agraria e medicina veterinaria; Economia e scienze politiche; Giurisprudenza; Ingegneria; Medicina e chirurgia; Psicologia; Scienze; Scienze umane, sociali e del patrimonio culturale)* (UniPd, n.d.).

[2] The specific number is decided yearly upon agreement between the University and the territorial need for teachers (Eurydice, 2018b).

Zooming in on the specific course observed in the research, there is *Methodologies, Didactics and Technologies for Teaching* (*Metodologie didattiche e Tecnologie per l'insegnamento*), hosted by Professor M. D. R. who has a background in education and training.

Following van den Akker's (2003) model for curriculum analysis, the main features of this course[3] appear as follows:

1. *Rationale:* the course moves from the consideration that technology is a powerful variable in teaching methods and didactic considerations. By giving an overview of the main teaching methods, strategies, formats and techniques, along with presenting several technological tools, the course wants to foster student-teachers' conception of technology integration in teaching and learning.

2. *Aims & objectives* are related to theoretical knowledge on the links between methodological-didactic and technological concepts, declined according to specific disciplinary contents. The course also wants to offer operative procedures to apply such theoretical knowledge in technologically integrated lesson plans.

3. *Content*: several theoretical definitions for teaching models, approaches, method and methodology, format, strategies and techniques are provided. Technologies as teaching tools for (pre-)primary education are also considered, in their potentialities for integrated teaching contexts and specific affordances. The course presented tools for concept mapping and digital narratives, apps and platforms, educational robotics, multimedia and hypermedia. Finally, along with instructional design notions, theories like TPCK and meaningful learning were presented in their alignment to teaching approaches with technology.

4. *Learning activities*: the course comprised 13 weeks of lecture and workshop lessons. While the course itself was mandatory, attendance was compulsory only in workshop sessions. During lectures students were required mainly to listen, read PowerPoint slides, take notes and intervene when asked. Workshops addressed different school subjects and were accessible upon personal students' preference up to availability (30 places). Here, students were actively engaged in group works where to perform instructional design. Finally, they were required to autonomously research and write a report on possible technological affordances for educational purposes.

[3] The information hereafter reported was gathered through participant observation during the implementation of said course and thanks to the document analysis of the course materials, available either on the University Platform webpage, or in hard copy. The main reference for this paragraph is De Rossi (2018a), in Appendix 1.2a.

5. *Teacher role*: the course's Professor personally delivered all the lectures and collaborated with the workshop tutors for the definition of the workshop's aims and main characteristics. All academic figures involved (Professor and tutors) were active on the university platform to supervise online-based activities and share documents and information. The Professor was also available for weekly office hours.

6. *Materials and resources*: the course syllabus mentions several hard copy materials to support content learning (De Rossi, 2018a), mainly book chapters and monographies.

7. *Grouping*: students were involved in plenary session work (during lectures), group work (in the performance of instructional design tasks: 30-32 students per workshop, then divided in groups of 3-5), individual work (in the final exam), and online participation on the University platform.

8. *Location*: the course took place in the University buildings in Padova (IT). Lectures were set in 250-student-capacity classrooms with fixed seats, equipped with a ceiling-mounted projector, a desktop computer and no Wi-Fi connection. Workshops were set in several smaller rooms in the various University building (max 30-student-capacity), among which a computer lab equipped with 30 desktop computers, non-fixed seats, one ceiling-mounted projector and no Wi-Fi connection.

9. *Time:* the 13 course weeks took place in autumn 2018, from October to December. Weekly lectures were carried out for a total of 4.5 hours per week, while workshops added up to a total of 24 hours[4] split in two moments of the academic year: November 2018 and January 2019.

10. *Assessment*: students' assessment was carried out on their performance on the final written exam (70%) about theoretical notions and possible practical realizations of technology integration in education; and on their two technology-enhanced design products (15+15%).

Given this background information on the specific course observed, the next paragraphs will zoom in on the students attending the course, as active participants to the research.

[4] The reported timeframe refers to the single workshops, each welcoming groups of up to 30 students. There was a total of 6 workshop groups, each of the duration of 12+12h.

4.2.4 Selected participants

Participants to the present research were student-teachers enrolled in the *Methodologies, Didactics and Technologies for Teaching* course (*Metodologie didattiche e Tecnologie per l'insegnamento* - §Chp.4.2.3). The total amount of students enrolled to this course in the academic year 2018/2019 was 199. It should be noted that this was one of the mandatory courses set at the second year in the five-years Master's degree in Primary Education Sciences. The following participants' description evolves from data collected through (a) participant observation of the researcher (§Chp.3.2), and (b) the pre- questionnaire (§Chp.3.4) administered face-to-face and filled in online, to the entire student population enrolled at the course on its first week in, in October 2018. The collected pre-questionnaires amount to 164.

Participants' features here described were addressed in questionnaire's sections 1 (*demographics*), 2 (*knowledge of use of technologies*), 3 (*frequency of personal use of technologies*) and 6 (*perceived contextual support to technology integration in education*).

Of the 164 respondents, 96% were female, with only 6 male student teachers (4%). Most of them were aged between 17-22 (81% - see Figure 4.5), even considering gender populations. The majority of these student-teachers were at their second year at university (97%) and at their first university level experience with a course on technology integration (92%). The remaining 8% includes older students, still attending their second year at this University Program. This might suggest some external educational experiences on the topic, for them.

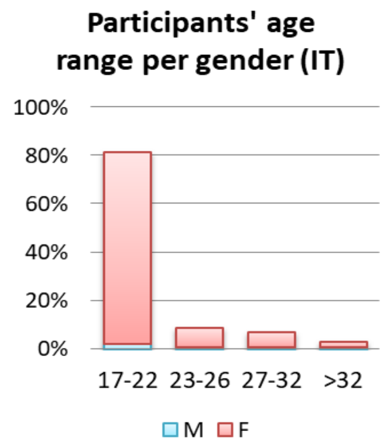


Figure 4.5 Participants' demographics – age and gender (IT).

Overall, these demographics seem to agree with the University Program structure for Primary Education (§Chp.4.2.3): the *Methodologies, Didactics and Technologies for Teaching* course is expected to be attended by second year students (likely to be young) and it is mandatory, so there is the possibility to have older students re-taking it if previously failed. The huge gender disparity could account for a different appeal of the teaching profession, especially at lower grades, for Italian boys and girls, as documented for the European context (OECD, 2018).

When asked if they had any teaching experience in formal or informal education (Figure 4.6), 66% of the respondants reported none, while among the 34% remaining the highest answer readed *other* (22%), specified in baby-sitting activities, peer tutoring to fellow students or private lessons to younger students. Among the participants claiming some form of teaching experience, the majority (56%) reported never using technology in their practice (against the 13% experiencing technology in every practice and 31% in most of them). Regardless of their actual experiences with technologies in education, every participant but two reported to own at least one personal device (desktop computer, laptop or iPad) connected to the internet.

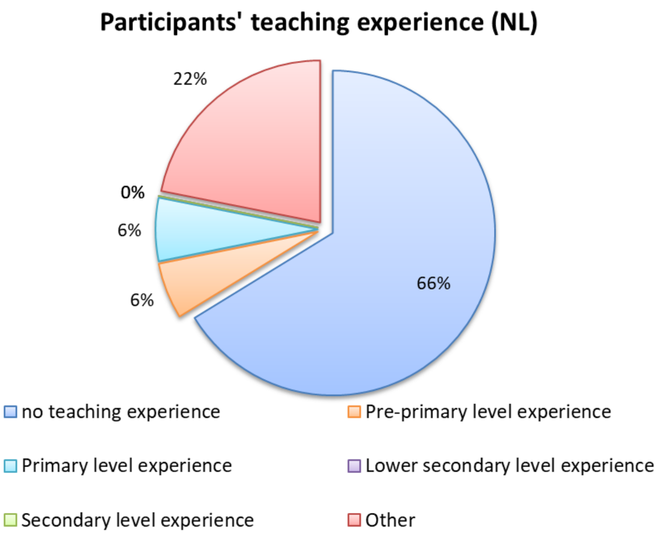


Figure 4.6 Participants' demographics - Teaching experience (IT).

Participants' familiarity with technology use was surveyed in terms of technical skills and frequency of use of those technologies. Once again, it is to highlight that the frequency measure is inevitably be influenced by access to the tools, which varies among the three cases implied in the research (see §Chp.3.4).

As explained in the methodological chapter (§Chp.3.4), the *knowledge of use of technologies* section of the questionnaire was analyzed according to three factors:

1. *lower order digital applications and software* (α= .82), e.g. Office suite, databases, online collaboration platforms;
2. *higher order digital applications and software* (α= .89), e.g. concept mapping tools, programming languages, simulations;
3. *common internet use* (α= .85), e.g. email system and internet browsing.

As for the access, *frequency of use of technologies* was analyzed according to these same factors, plus the reference to *gaming and social* tools uses.

Italian student-teachers (Figure 4.7) reported a slightly-below average knowledge of use of *lower order technologies* ($\bar{x}$=2.8 over 5[5], σ =0.7), with an associated

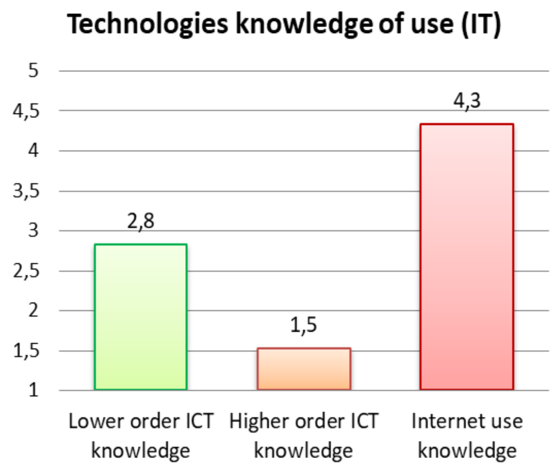


Figure 4.7 Participants' demographics - knowledge of technology use, means (IT).

[5] As the reader might recollect, data refer to a 5 point Likert scale (§ Chp.3.4).

low frequency in their use ($\bar{x}$=2.5, σ =0.6). Even lower was the score reported on average about the *knowledge of use of higher order* technologies ($\bar{x}$=1.5, σ = 0.5; frequency $\bar{x}$=1.3, σ =0.4), the ones more specific to the teaching profession. To the contrary, the use of *internet-based apps and software* was rated quite high ($\bar{x}$=4.3, σ =0.6), associated with a similar level of frequency use ($\bar{x}$=4.6, σ =0.5).

Just a mention of the respondents' rate of their frequency of technology use for *leisure* purposes, as gaming or social networking: the mean was $\bar{x}$=3.2 (σ = 0.8) indicating just an average level of interest (and/or maybe access) to these technological affordances, not really expectable from a generation born in the early 2000s (Eurostat, 2017).

Finally, some details on the respondents' perception of support from their social and academic context, regarding ICT integration in education. Again, with reference to §Chp.3.4, the questionnaire's section of *Contextual support* was analyzed through 3 factors:

1. *surrounding encouragement* (α=.79), e.g. perceiving inputs from dear ones, fellow students or other teachers to integrate technologies in everyday practice;

2. *equipment* (α= .83), e.g. observing the adequacy of university and schools' infrastructure to enable technology integration;

3. *university's active role* in supporting the students (α=.92), e.g. recognizing didactic strategies to actively show, discuss, experiment and support technology integration practices.

Italian participants' answers overall gathered around the middle score for all three factors (Figure 4.8), with a slightly lower appreciation of the *university strategies*, especially when looking at the fairly better overall *encouragement* perceived. Considering that these are student – teachers' perceptions at the beginning of the educational course for technology integration, by their own assertion the first ever attended on the topic, such answers seem to at least not pose serious barriers to improvement.

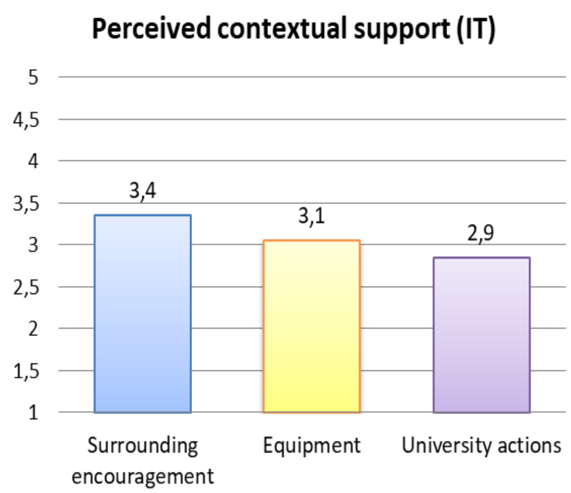


Figure 4.8 Participants' demographics - perceived contextual support, means (IT).

The data just presented are meant to help understanding the participants' characteristics at the beginning of the academic course observed. They would suggest that no strong barriers were perceived when it came to access different kinds of technology or be supported by the context/university to do so. The initial little-to-none teaching experience, associated with a low knowledge of educational technologies could help within the present research in understanding the eventual impact of the academic course for technology integration in education, on pre-service teachers.

4.3 DUTCH CASE CONTEXT

The Netherlands (Picture 4.6) is the third case considered in the present study, situated in the northern part of Europe.

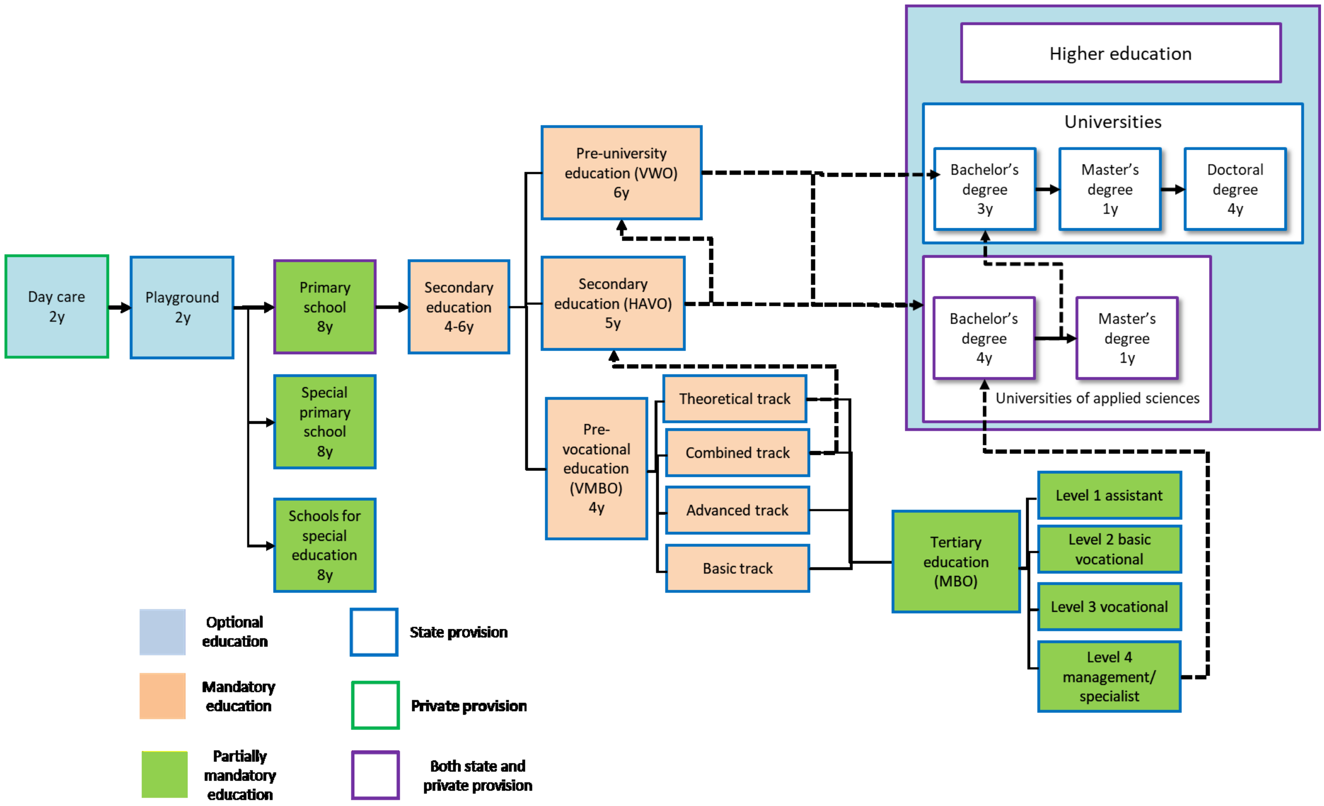
Picture 4.6 The Netherlands in the world (Wikipedia, n.d./c).

4.3.1 Educational system and path to become a teacher

Education in The Netherlands is main responsibility of the Ministry of Education, Culture and Science (*OCW*), although the governance is decentralized for matters like staff hiring and management. The Ministry identifies the main guidelines for attainment targets at the different levels, while there is no national curriculum (Eurydice, 2018c). The Dutch Constitution (art.23) reads that although education is to be constant concern of the Government, every person is free to provide education (Home Affairs and Kingdom Relations, n.d.). This explains the multitude of different types of schools, e.g. according to different religious confessions.

Compulsory education lasts for 13 years, between pupils' age 5 and 18, and it is free of charge for Dutch and EU residents, although families might be encouraged to give contributions according to the specific school organization. Overall, the Dutch educational system appears quite complex. To help giving a clearer picture of it, in the next paragraphs the different academic levels will be detailed in terms of governance's affiliation, typology and main characteristics. Particular attention will be given to educators' requirements and qualifications, per school level.

This information is meant to better understand both participants' upbringing (e.g. the rigid school level classification) and the school system for which they are being trained. For an easier reading, the main information is being synthetized in Table 4.3 and Picture 4.7.



Picture 4.7 Dutch educational system.

Table 4.3 Dutch educational system.

Name			Affiliation	Types	Pupils' age	Educational aims	Teachers' qualification	Legislative regulations
Early Childhood Education and Care (ECEC)	Pre-primary		Private institutions	Day care	6-8 weeks to 2y	To satisfy the basic needs of the child; foster equity and increase the participation of students from disadvantaged backgrounds.		Quality and Education Act (*OKE*-2010) Childcare and Quality Standards for Playgrounds Act (2010)
			Municipalities	Playgrounds	2-4 y	To develop pupils' language and social skills, mainly for pupils at educational risks		
Primary education			Ministry of Education, Culture and Science	Mainstream public primary schools (*basisonderwijs BAO*)	4-12 y (compulsory from age 5)	To provide students with government-decided attainment targets (*kerndoelen*) for Dutch and English, mathematics, social and environmental studies, creative expression and sports. It ends with an attitudinal test (*CITO-toets)* that, along with the pupil monitoring system (*leerling-volgsystem*) leads to a final recommendation for the secondary education path to pursue.	Bachelor's degree in PABO, Primary school teacher training, available at HBO and University	Education professions act (2006) Good Education and Good Governance Act (2010) Primary Education Act (2010) Expertise Centres Act (1998)
				(Non-denominational) primary schools				
				Religion-related primary schools				
				Internationally oriented primary schools				
Secondary education	General secondary education (*algemeen voortgezet onderwijs*)	Pre-university education (*voorbereidend wetenschappelijk onderwijs VWO*)	Ministry of Education, Culture and Science	gymnasium	12-18y	To prepare students to higher-level studies	Grade two (Bachelor's) qualification for years 1-3 of VWO and HAVO; all years VMBO. Grade one (Master's) qualification for every school year in VWO, HAVO and VMBO.	Education professions act (2006) Good Education and Good Governance Act (2010) Secondary Education Act (1998)
				atheneum				
		General secondary education	Ministry of Education, Culture and Science	*Hoger algemeen voortgezet onderwijs HAVO*	12-17y	To prepare students for professionally oriented higher education		
	Pre-vocational secondary education (*voorbereidend middelbaar beroepsonderwijs VMBO*)	Technology learning track (*techniek leerweg*)	Ministry of Education, Culture and Science Or Private	Basic vocational track* (*basisberoepsgerichte leerweg*)	12-16y	Strong technical and vocational perspective to prepare students to enter the labour market in services, industry and handicraft sectors		
		Health and personal care and welfare track (*zorg en welsijn leerweg*)		Advanced vocational track* (*kaderberoepsgerichte leerweg*)				
		Economic learning track (*economie leerweg*)		Combined track* (*gemengde leerweg*)				
		Agriculture learning track (*landbouw leerweg*)		Theoretical track* (*theoretische leerweg*)				
Tertiary education		Vocational education (*middelbaar beroepsonderwijs MBO*)	Ministry of Education, Culture and Science	Qualification level 1, assistant training (*assistentopleiding*)	16y+ for up to 4y	To develop professional specialization for the labour market, in areas of services and productive sectors	n.d.	n.d.
				Qualification level 2 basic vocational training (*basisberoepsopleiding*)				
				Qualification level 3 vocational training (*vakopleiding*)				
				Qualification level 4 management training (*middenkaderopleiding*) or specialist straining (*specialistenpleiding*)				

(continues)

Name	Affiliation	Types	Pupils' age	Educational aims	Teachers' qualification	Legislative regulations	
Higher education	Government-funded institutions (*bekostigde*)	Ministry of Education, Culture and Science	University (*Universiteit*)	18y+	To prepare students for academic careers, focused on research	Master's degree minimum qualification	n.d.
	Approved institutions (*aangewezen*)	Private institutions	University of applied sciences (*HBO*)	17y+	Prepare students to enter the labour market, with practical reasearch attitudes		
Special education	Special schools for primary education	Ministry of Education, Culture and Science	*Speciaal basisonderwijs (SBAO)* schools	4-12y	To provide pupils with all the necessary facilitations and support needed to ensure the best possible educational outcome in terms of personal autonomy and basic skills	Bachelor's degree in PABO, Primary school teacher training, available at HBO and University. Possible master's degree in special need teaching	n.d.
	Schools for special education (*special onderwijs* schools)		Schools for visually impaired pupils				
			Schools for pupils with language and hearing disorders				
			Schools for cognitively impaired pupils				
			Schools for students with behavioural disorders				

*Each VMBO track is split in the same 4 levels
Single line: alternative affiliation options.
Dotted line: educational alternatives within the same school type.
Double line: alternative educational paths within same grade level.

Early childhood and primary education

The pre-school system is regulated by the *Opportunities for Development through Quality and Education Act* (*OKE*) of 2010, aimed at aligning playgroups and day nurseries to national education quality criteria. Pre-primary realities welcome pupils from 6-8 weeks to 4 years in either day nurseries or playgrounds. While the first aim is to provide for the basic needs of the children, fostering equity and participation, they also want to help specifically students at risk of educational disadvantage (e.g. bilingual students – OECD, 2014). Educators working at this educational level are not required to hold any teaching qualification (Eurydice, 2018c).

Mandatory education starts when the child is five years old, even though primary schools welcome students from their 4th year of age. As any of the educational levels beyond ECEC, primary education is regulated by OCW and is offered in forms of non-denominational, religion-based and international primary schools (OCW, n.d.). They all need to comply with national standards for the primary school standards (Benchmarks Act, 2010; UNESCO, 2012).

Primary education comprises 8 years of free and compulsory education, offering classes in Dutch, English, mathematics, social studies, creative expression and sports (OCW, n.d.). These are defined in terms of attainment targets (*kerndoelen*) that every pupil is supposed to master by the end of this education level. At the conclusion of the 8th year of primary school, students are required to sit a primary school leavers' attainment test (mainly as *CITO-toets*) which measures their skills in language, mathematics and arithmetic (UNESCO, 2012). While it is not a pass/fail exam, the results figure in an official recommendation for the pupil's family about the choice of the next educational level.

Finally, some details on special education in the pupils' early years. Dutch school system identifies children with special needs from an early age and suggests a specific education path accordingly (Eurydice, 2018c). When mainstream education is not possible, pupils are welcome to attend special primary schools (for students with lighter disabilities and/or learning disadvantages) or schools for special education according to the specific impairment (OECD, 2014). These last schools also help pupils who need ortho-pedagogical and ortho-didactical support in completing their compulsory education (Eurydice, 2018c).

Secondary and higher education

Secondary education comprises several educational paths, all under the main OCW governance, admitting pupils mainly according to their CITO-toets score levels (Nuffic, 2018) and teachers' recommendations. Pre-university secondary schools *(voorbereidend wetenschappelijk onderwijs VWO)* welcome children with the highest CITO-toets scores and last for 6 years, closing with a leaving exam on 7 core subjects.

The second-to-highest secondary educational level is offered at general secondary schools (*hoger algemeen voortgezet onderwijs HAVO)* which last 5 years and end with a national examination on 6 core subjects. HAVO shares with VWO the general curriculum offer, although the specific contents and teaching methodologies are more oriented towards a possible professionalization. HAVO also guarantees the access to Higher education in the Universities of applied sciences (*HBO*).

Alternatively, students may attend pre-vocational secondary education *(voorbereidend middelbaar beroepsonderwijs VMBO)*, which lasts 4 years and comprises four different educational tracks: (a) technology; (b) health care and welfare; (c) economy; and (d) agriculture. Each of these tracks comes in four increasing levels. While the specific subjects are different in the four levels and in the four tracks, the main aim of this broad educational path is to prepare students to enter the labour market, especially in areas of services, industries and handicrafts (Nuffic, 2018).

As students leaving VMBO are still subject to compulsory education, they are welcome to access tertiary vocational education (*middelbaar beroepsonderwijs MBO*) which lasts up to 4 years, depending on the specific track to be chosen among four levels: assistant training; basic vocational training; vocational training; and management or specialist training. MBO wants to further develop students' professional specialization for the labour market, but on its fourth and highest level (specialist training) also provides access to Higher education at Universities of applied sciences (HBO). Students completing the two highest levels of VMBO (combined and theoretical tracks) can also opt to attend the final two years at HAVO, to upgrade their education and try to access higher education (HBO).

Higher education itself is offered in two options: at Universities and at Universities of applied sciences. Universities offer Bachelors, Masters and Doctoral programmes open to students holding any VWO diploma.

Universities of applied sciences (HBO) offer Bachelors and Master programmes to students from the VWO and HAVO paths, or holding equivalent diplomas. Additionally, at the end of a bachelor's course in these Universities of applied sciences, students can access Universities' bachelor's degrees and further advance in their education (Nuffic, 2018).

Teacher education and training

OECD's Teaching and Learning International survey (2013) reports a higher than average proportion of Dutch teachers who consider teaching profession as valued in society and would choose it again if given the chance. To pursue such career, there are several possibilities.

If one wishes to work at the primary education level, it is necessary to obtain a Primary teaching certificate, released by both HBO institutions and Teacher Training Colleges (*PABO*). Over 30 HBO institutions offer these qualifying courses and welcome every year between 8000 – 9000 students all over the country (Eurydice, 2018c). These courses (240 ECT) usually last 4 years, with a first propaedeutic part (freshmen year) and a main part (last three years). They include also in-the-field internship experiences amounting to about a quarter of the entire program, beginning in the first year. By the last year, student-teachers can work part time at their training school, albeit for no more than five months. A qualified primary school teacher can teach in any grade any subject except for physical education (only teachable at 1st - 2nd grade without a specific postgraduate qualification) and can work in primary and secondary special education institutions (*speciaal onderwijs*). Even if not mandatory, teachers working at special schools may complete a Master's degree in special education needs, where to obtain a specialization on a particular type of impairment of choice (Eurydice, 2018c).

Secondary school teachers are specialized in the subject to teach and need to have either one of these distinct teaching qualifications:

- Grade Two qualification, which allows to teach only at the first three years of HAVO and VWO, and any year of VMBO and vocational education;
- Grade One qualification, which allows to teach at any level of any secondary education path.

Either qualification process can be completed at HBO institutions and universities. HBOs provide Grade One and Two qualifications at the end of 240 ECTS, 4-years programmes, where student-teachers are trained on the specific desired subject, and general teaching methodologies. Additionally, there are nine universities in the country which provide a Grade One qualification, within postgraduate teacher training courses (60 ECT credits). Any teaching qualification process for secondary education includes also teaching practice: student-teachers make experiences in the subject areas in which they intend to work, practicing for 840h. As for the primary teachers, during their final year of education, secondary school student-teachers can be employed part time in their training school, albeit for not more than five months, becoming *LIO* (trainee teachers). These work periods at school are meant to minimize the possible reality shock when the student-teachers will actually enter the profession (Nuffic, 2018).

4.3.2 Dutch educational policies for technology integration in education

Dutch government is deeply interested in science, technology and innovation as factors for the social and economic development of the country in the knowledge society (UNESCO, 2012).

Since the early 2000s, the Dutch government devolves vast funds to provide infrastructure and human resources for effective technological actions in education, especially in the perspective of improving the workforce qualification for science and technology careers (De Boer & van Steen, 2006; UNESCO, 2012). For example, the *Innovation Platform* was created and installed already in 2003, with the publication of a green paper for a knowledge investment agenda 2006-2016 (De Boer & van Steen, 2006). As a result, science and technology are gaining space and importance in the educational system, with a wide use of these platforms in the schools and the implementation of programmes like the *Broadening Technology in Primary Education* (*VTB).* VTB already counted on a network of over 2500 primary schools by the end of 2010, working together to translate national guidelines in technological competences for teachers and students (van der Molen, van Aalderen-Smeets & Asma, 2010).

While the actual use of technologies, especially in primary education, is not laid down by law (Eurydice, 2018c), nearly all teachers use digital learning materials and the internet, operating in well-equipped classrooms (in 2018, 98% of them had electronic whiteboards and an average of one computer every 3.5 pupils – Eurydice, 2019). Widespread is also the use of digital tracking systems to monitor pupils' learning progresses through their educational career (Eurydice, 2018c; Smeets & van der Horts, 2018). Crucial in the provision of infrastructure and training about technologies in education is the *Kennisnet public organization for Education & ICT*. In their 2018 report on the uses and perceptions of ICT at school, they suggest that teachers, at any level, see a major improvement of pupils' motivation through the use of ICT (Smeets & van der Horts, 2018). On the school leaders side, Kennisnet's report states that they expect that through the use of ICT pupils will benefit from a more tailored educational experiences in terms of content, instruction for and learning pace (Smeets & van der Horts, 2018).

4.3.3 University of Applied Sciences of Windesheim: Education Department

Windesheim University of Applied Sciences was first formed in 1986 through the merge of several education providers as, among the others, the academy for Journalism and the one for Social Studies; the School of Physical Exercise; the College of Education, the School of Nursing and the Higher Education in Information Technology. Today, it counts over 25 000 enrolled students, with an academic and administrative staff of roughly 2000 individuals between the campuses of Zwolle and Almere (Windesheim, n.d./a).

From its statute the main aim of the University appears to be to "actively contribute to an inclusive and sustainable society, by educating valuable professionals and conducting practice-oriented research" (Windesheim, n.d./a, p.1). Windesheim offers small classes of 15-20 students in a personalized learning perspective, and has a close connection with the business community and public institutes for job placement after graduation. Overall, it provides over 50 Bachelor programmes in different fields of expertise: Business, Media and Law; Education; Engineering and ICT; Health and Social Work; Journalism and Communication; and Sport and Therapy. It is also possible to choose among 9 different Master programmes, one of which is taught in English (Master of Psychomotor Therapy).

Admission to the University requires the completion of a certain type secondary school (§Chp.4.3.1): either VWO or HAVO (including secondary tracks like the completion of the higher VMBO levels plus the completion of the last HAVO year), or the completion of the highest level at MBO education.

Windesheim organization is declined in four Divisions[1], each with its own study programmes and research centres: (1) Engineering and ICT Division (with the Technology Research Centre); (2) Human Movement and Education Division (with the Education Research Centre and the Human Movement and Sports Research Centre); (3) Business, Media and Law Division (with the Strategic Entrepreneurship Research Centre); and (4) Health Care and Social Work Division (with the Health Care and Social Work Research Centre and the Media Research Centre) (Windesheim, n.d./a).

The Human Movement and Education Division houses, among the others, the Teachers College study program (for either a Primary or Grade Two qualification), and the University Teacher Training Program (*PABO* – specialized for primary school teachers-to-be – Windesheim, n.d./b). The main aim of the two programmes is to train researcher-teachers, qualified to teach at the different levels of education and working with a researcher-like attitude (Windesheim, n.d./b).

[1] A fifth one could be considered the one situated in Flevoland, whereas all other four are in Zwolle (NL – Windesheim, n.d./b).

Particularly relevant seems the focus on practice, as internships at school are mandatory since the beginning of either program, along with more academic subjects like teaching methodology, subject content courses, and theory and research methods (Windesheim, n.d./b).

Zooming in to the specific course observed in the present research, there is *Learning and ICT* (*Leren & ICT* – 30 ECTS), hosted by Professor R. B. (and colleagues), with a background as secondary teacher. Following van den Akker's (2003 – Picture 4.1) model for curriculum analysis, the main features of this course[2] appear as follows:

1. *Rationale:* the course moves from the consideration of the increasing demand of technologically-savvy teachers, wanting to "contribute to the education of future teachers with a clear vision of the use of ICT in the classroom" (Breukelman, 2018, p.1). A strong perspective on facilitating pupils' learning with good-quality teaching materials is also implemented.

2. *Aims & objectives:* this course wants to improve student-teachers' 21st century skills and a professional perspective through design teams practices (within the ADDIE framework), improving their capabilities to identify, analyse and implement effective technological means in education.

3. *Content*: some theoretical pedagogical-didactic models are presented, like ADDIE (*Analysis, Design, Development, Implementation, Evaluation* – van den Akker & Thijs, 2009), SAMR (*Substitution, Augmentation, Modification, Redefinition* – Puentedura, 2006), Bloom's taxonomy (Valcke, 2010), Meaningful Learning (Howland, Jonassen & Marra, 2012) and TPACK (*Technological, Pedagogical And Content Knowledge* – Mishra & Koehler, 2006). Furthermore, the course addresses technologies as teaching tools for primary/lower secondary school teachers, considering the potentialities for learning and specific affordances and presenting examples for concept mapping, digital narratives, apps and platforms, educational robotics, multimedia and hypermedia.

4. *Learning activities*: the course comprised 14 weeks of lessons. The course itself is a Minor, electively chosen by students, but attendance was compulsory. During the sessions, students were required to listen, read PowerPoint slides, take notes and actively participate to discussions. Usually, the first part of the session was a theoretical/lecture-based lesson form,

[2] The information hereafter reported was gathered through participant observation during the implementation of said course and thanks to the document analysis of the course materials, available either on the University Platform webpage, or in hard copy. The main documentary reference for this paragraph is Breukelman (2018), in Appendix 1.3a.

while the second part required practical group activities (e.g. where to perform instructional design). Students were asked to autonomously research on possible technological tools or issues for technology integration in education and present them at the beginning of every session. Finally, student groups were required to implement their instructional design products (second cycle) in a school collaborating with the University.

4. *Teacher role*: the Professor and his colleagues personally delivered all the lectures and monitored the group works. All academic figures involved (Professor and colleagues) were active on the University Platform to supervise online-based communications and share documents and information. They were also available for weekly office hours.

5. *Materials and resources*: the course syllabus mentions several online materials to support content learning, available as links on the University Platform, mainly peer-reviewed articles and professor-authored materials (Breukelman, 2018).

7. *Grouping*: students were involved in plenary session work (during lectures), group work (in the performance of instructional design tasks: 3-4 students per group), individual work (in the feedback reports), and online participation on the University platform.

9. *Location*: the course took place in the University buildings in Zwolle (NL) and at the different schools' locations also in Zwolle. Lectures were set in classrooms with mobile seats, equipped with a ceiling-mounted projector, a desktop computer and Wi-Fi connection. Every student usually brought his/her personal device to the lecture.

10. *Time:* the 14 course weeks took place in Spring 2018, from January to June. Weekly sessions were carried out for a total of 10 hours per week (6 + 4), although only part of these required face-to-face participation of the people involved (during group work activities, some of the students might exit the classroom and work autonomously, submitting then the required product by the end of the session).

11. *Assessment*: students' assessment was carried out on their performance on the mid-term and final exams. Both of them dealt with the instructional design products developed, as well as with theoretical notions addressed in the course and proofs of a researcher-like mental habit.

Given this background information on the specific course observed, the next paragraphs will zoom in on the characteristics of the students attending the course, as active participants to the research.

4.3.4 Selected participants

Participants to the present research were student-teachers enrolled in the *Learning and ICT* course (*Leren & ICT* – §Chp.4.3.3) in the Teacher Training curriculum. The total amount of students enrolled to this course in the academic year 2017/2018 was 13. It should be noted that this was not a mandatory course at this point of their curriculum, but an elective Minor. The following participants' description derives from data collected through (a) participant observation of the researcher (§Chp.3.2), and (b) the pre-questionnaire (§Chp.3.4) administered in presence and filled in online, to the entire student population attending the lectures on the first course week, in January 2018. Eleven out of the thirteen enrolled students participated in the pre-questionnaire.

Participants' features here described were addressed in questionnaire's sections 1 (*demographics*), 2 (*knowledge of use of technologies*), 3 (*frequency of personal use of technologies*) and 6 (*perceived contextual support to technology integration in education*). In order to better represent the characteristics of this small numbered group of participants, data will be presented in raw frequencies as well as percentages, and Mode (Mo) and range values will be preferred to the Mean.

Among the 13[3] preservice teachers were involved in the study, 77% (n=10) were male, while only 33% (n=3) female. Most of them were aged between 17-22 (69%, n=9), with reference to both males (7 out of 10) and females (2 out of 3 – see Figure 4.9). The majority of the participants was at their third year at university (92%, n=12), with one exception at the fourth year. Moreover, none of them reported having attended any previous university-level course on ICT integration in education. These data seem to agree with the University Program structure for Teacher education (§Chp.4.3.3): the *Learning and ICT* course is expected to be attended by third year students (likely to be young) and is elective, so there is the possibility to have older students taking it to complete their academic career later on.

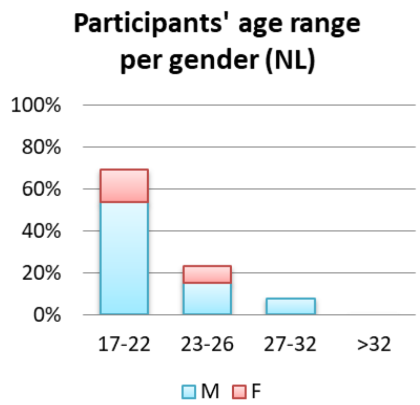


Figure 4.9 Participants' demographics – age and gender (NL).

These student-teachers were completing their teacher training for different school levels: four of them (one female, three males) for the Primary school level, eight for the lower secondary level (two females, six males), and one male in Religion across the school levels. The huge gender disparity could account for a different appeal of the teaching profession for Dutch boys and girls,

[3] Thanks to participant observation data as gender, age and year at university was collected about every participant, regardless of their answering to the questionnaire. Information here reported was authorized by the participants.

considering the majority of future higher grades teachers, as documented for the European context (OECD, 2018).

When asked if they had any teaching experience in formal or informal education (Figure 4.10), 73% (n=8) of the respondants[4] reported none, while among the other 3 students, two report experiences at lower secondary level and one in private tutoring. Among the three respondents claiming some form of teaching experience, two reported often using technology in their practice, while the third just seldom. Regardless of their actual experiences with technologies in education, every participant reported to own at least one personal device (desktop computer, laptop or iPad) connected to the internet.

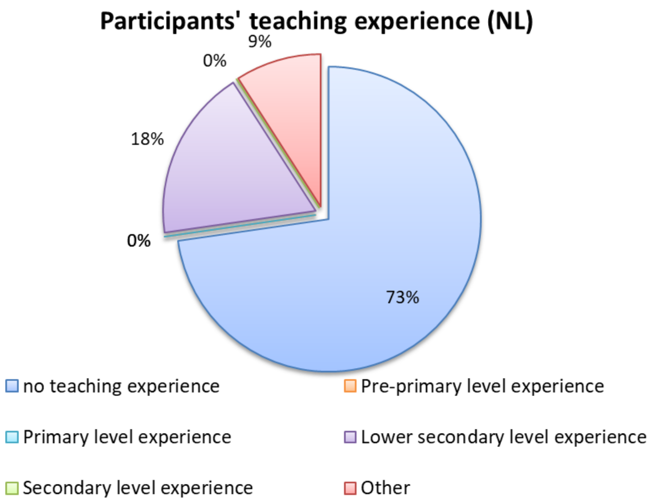


Figure 4.10 Participants' demographics - Teaching experience (NL).

Participants' familiarity with technologies was surveyed in terms of technical skills and frequency of use of those technologies. The reader should be reminded that the frequency measure is inevitably influenced by access to the tools, which varies among the three cases implied in the research (see §Chp.3.4). As explained in the methodological chapter (§Chp.3.4), the *knowledge of use of technologies* section of the questionnaire was analyzed according to three factors:

1. *lower order digital applications and software* (α= .82), e.g. Office suite, databases, online collaboration platforms;
2. *higher order digital applications and software* (α= .89), e.g. concept mapping tools, programming languages, simulations;
3. *common internet use* (α= .85), e.g. email system and internet browsing.

As for the access, *frequency of use of technologies* was analyzed according to these same factors, plus the reference to gaming and social tools uses.

[4] The data hereafter reported are related only to the answers provided by the eleven respondents to the entry questionnaire.

Observing the responses of Dutch student-teachers entering the course (Figure 4.11), it emerges a mildly positive reported knowledge of use of *lower order technologies* (Mo=2.9, range 2.5), with a similar score on their *access* (frequency Mo= 2.7, range 1.2). A lower familiarity is reported for *higher order technologies* (Mo=1.3, range 2.4), the ones more specialized for educational contexts, not really used by the participants (frequency Mo = 1 range 2). To the contrary, Dutch participants rated an extremely high score on the knowledge of use of *internet-based technologies* (Mo = 5, range 2), supported by a similarly high frequency of their use (Mo= 5, range 2).

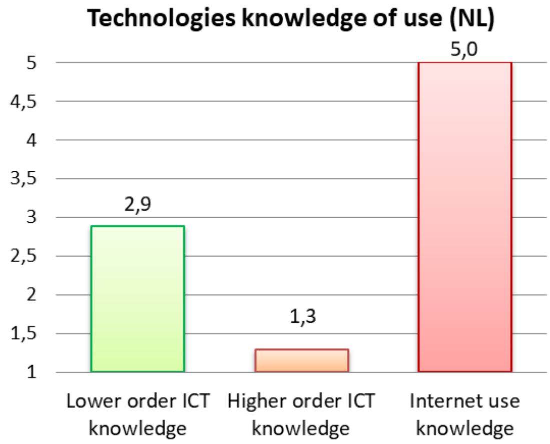


Figure 4.11 Participants' demographics – knowledge of technology use, Modes (NL).

A brief mention of the respondents' rate of their frequency of technology use for *leisure purposes*, as gaming or social networking. A mode at the highest value (5) indicates a great level of interest (and/or maybe access) to these technological affordances, as reported by some researches on Dutch young adults (Eurostat, 2019).

Finally, some details on the participants' perception of support from their social and academic context, regarding ICT integration in education. Once more with reference to §Chp.3.4, the questionnaire's section of *Contextual support* was analyzed through 3 factors:

1. *surrounding encouragement* (α= .79), e.g. perceiving inputs from dear ones, fellow students or other teachers to integrate technologies in everyday practice;
2. *equipment* (α= .83), e.g. observing the adequacy of university and schools' infrastructure to enable technology integration;
3. *university's active role* in supporting the students (α= .92), e.g. recognizing didactic strategies to actively show, discuss, experiment and support technology integration practices.

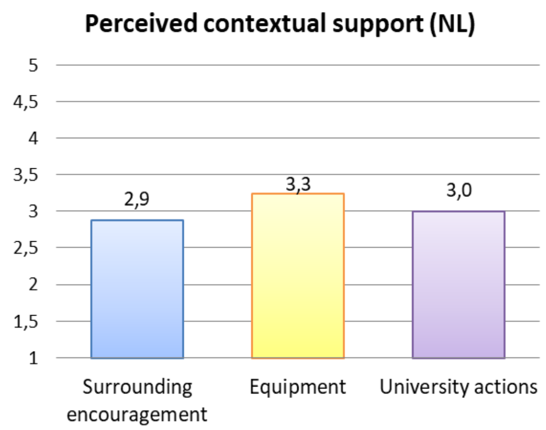


Figure 4.12 Participants' demographics – perceived contextual support, Modes (NL).

Dutch participants answered roughly around the middle score on all three factors (Mo 2.9 – 3.3, range 1.9 – 3, Figure 4.12) indicating an average appreciation of their contextual support for technology integration in education.

Considering that these are student – teachers' perceptions at the beginning of the educational course for technology integration, by their own assertion the first ever attended on the topic, such answers seem to at least not pose serious barriers to improvement. Nevertheless, the skepticism possibly suggested by the last data mentioned should be further inspected and likely addressed by the university.

The data just presented are meant to help understanding the participants' characteristics at the beginning of the academic course observed. They would suggest that no strong barriers were perceived when it came to access different kinds of technology or be supported by the context/university to do so. The initial overall lack of teaching experience, associated with a low knowledge of educational technologies could help within the present research in understanding the eventual impact of the academic course for technology integration in education, on pre-service teachers. Finally, the quite high range of answers in the different sections seem to indicate a non-homogeneous group of participants, although that data could be explained also by the small sample on which the statistic was run. Further inspection of the answers would be advised, and it was indeed carried out through observation and interview means for data collection, as will be described in the next section (§C-Chp.3).

Section C.
Single Case Reports

SECTION INTRODUCTION

In this section the single cases' findings will be reported, pursuing a context-sensitive answer to the overall research question (Yin, 1994). The three cases will help understand the occurrence of the phenomenon at stake (i.e. student-teachers' pedagogical reasoning in technology-integrated design tasks) and its multiple and diverse manifestations (Stake, 2006).

Findings for each case study will be presented through a common structure following the research sub-questions 1-3 (§B- Chp.1) respectively on design task procedures, dispositions toward technology integration, and pedagogical reasoning instances. These data will contribute to inform an answer to the overall research question, on a single-case level, which will be presented at the end of every report.

As the analyses carried out on data and the modalities of findings' presentation will be shared by the three contexts, they will be introduced now as guide to the reader.

First sub-question

As described in §Section B, the first sub-question leading the present study investigated the TPCK-informed design task procedures implemented in each case study, their bounds to ICT integration models (§A-Chp.3.1) and to PR frameworks (§A-Chp.3.2). In order to answer this question, multiple instruments were adopted: documentation (§B-Chp.3.1), participant observation (§B-Chp.3.2) and focused interviews (§B-Chp.3.3). While for the portrayal of the academic courses the reader should refer to Section B (§B-Chp.4.1.3, 4.2.3, 4.3.3), here will be found the characterization of the task instructions and specific design procedure implemented in the single case studies, emerged from these data collection instruments.

First, the theoretical foundations of the single design task procedures will be detected in relation to theoretical models for ICT integration in education. Then, the procedures will be analysed using a PR lens, already modelled and described in §Section B (Chp.3.1). This, with the intent to understand how the materials and documents provided to the student-teachers intended technology integration and the realization of a related pedagogical reasoning.

Moreover, to further explore such connection to pedagogical reasoning, along with documentary analysis, the ways in which the three tasks and procedures were understood by student-teachers were also investigated. Thus, findings from the first and second rounds of interviews will be reported, in reference to the following codes:

- *Familiarity of the procedure*, useful to investigate possible previous experiences with a technology-enhanced design that might influence the current task's performance.

- *Relevance of the procedure*, analysed to understand if the student-teacher actually used the given guidelines in performing the task or relied on other resources (e.g. pre-made materials, past experiences and so forth). This also gave some insight on a performance orientation of the interviewees, which might have fostered passive execution over active reasoning

- *Understanding of guidelines*, considered to identify the main perceived difficulties in comprehending and performing the design task.

- *Technology integration requirements*, investigated to see how this issue was perceived by the student-teachers in relation to the procedure's conditions.

- *Overall perceived worth of the given procedure* as effective guidelines for designing a technology-integrated learning unit.

Second sub-question

The second sub-question leading this research is related to student-teachers' dispositions towards technology integration (§B- Chp.1). These were observed both when participants were just starting to deal with the issue (i.e. at the beginning of their university course and at their first concrete attempt to design with technologies) and when they had multiple experiences on it (i.e. at the end of their course and after yet another technology-integrated design cycle). As the reader might remember from Section B (§B-Chp.2.3), this is the mixed method section embedded in the wider research design (Creswell, 2013). The implemented instruments for data collection were a pre-/post- questionnaire (§B- Chp.3.4) and focused interviews (§B- Chp.3.3). Data were collected independently in the same time span (the five to six months of university course duration in each context), then merged when interpreting the results (parallel convergent mixed method – Creswell, 2013).

The single cases' findings from the quantitative and qualitative instruments will be presented according to the specific research question. First, participants' dispositions towards ICT integration at the beginning of their academic journey on this issue will be described, presenting the overall population and a typical student-teacher. Then, it will be observed if and how these dispositions changed after multiple experiences with TPCK-informed design tasks, for the student-teachers involved.

On the quantitative side, the questionnaire's factors (§B- Chp.3.4) considered to answer the sub-question at stake were:

- *Emotive signposts* (α= .90), further specified in:
    - *Emotive barriers* (α= .87) related to stress, frustration and difficulty in the approach to educational technologies; and
    - *Emotive enablers* (α= .82) related to comfort, ease and likelihood to include technologies in everyday practices.
- *ICT impact* on teaching and learning (α= .90), concerning the perception of technologies' influence on teaching and learning processes, as well as their worth; and
- *Lack of worth* of ICT (α= .70), related to the assumption of technologies' inconsequentiality if not even negative impact on teaching and learning processes.
- *Self-efficacy* (α= .93) regarding the self-assessment of the practical capability to integrate technologies for educational purposes.
- *TPCK in teaching practice* (α= .95) dealing with content-based, pedagogically – oriented, technologically-integrated practices;
- *TPCK awareness* (α= .82), concerning the approach to knowing ICTs for educational purposes.

When observing the changes between pre- and post-questionnaires, ANOVA tests were carried out on these factors, and also contextual measures of *knowledge* and *access of use of technologies*, and *contextual support appreciation* were considered.

Further analyses were carried out specifically on the dispositional factors abovementioned, as a two-step cluster analysis on both the pre- and post- questionnaire data. This was carried out through SPSS and it allowed to attribute respondents to clusters according to the similarity of their answering patterns on continuous variables (our factors), using distance measure as similarity criterion (IBM, n.d.). Interestingly, the emerging clusters were not case-specific (see §Section D), but for each case study only the student-teacher profile which gathered most respondents will be here introduced.

As for the qualitative side, some themes emerging from the interviews were considered to be merged with quantitative ones. These were related to the following codes and families (see also §B – Chp.3.3):

- *Emotive signposts*, further specified in
    - *Stress* and *avoidance*: codes related to student-teachers reporting anxiety/stress in, or fear/avoidance of using ICT, even in the educational environment;

- *Comfort:* codes related to participants reporting ease of use of ICT, likelihood to use it often, enjoyment in doing so, even in the educational environment;
- *Openness to integration:* codes related to student-teachers mentioning their degree of willingness to integrate technologies, moving through
  - *Cautious* level in which the student reports slight likelihood/ willingness/ openness to use ICT, even in education. It might be driven by external pressure (e.g. *I know it's important in education, so I have to improve*). The overall comment is sceptical, or restricted by other specific resistance, like social pressure, equipment or external limitation to ICT integration.
  - *Openness* level in which the interviewee reports a general likelihood/ willingness/ openness to use ICT, even in education. While it is not restricted by any explicit resistance, it is neither accompanied by strong reasons to actually integrate technologies, suggesting just a general positive intention in doing so.
  - *Reasoned openness* level in which the student-teachers mentions likelihood/ willingness/ openness to use ICT, even in education, giving further details on it (e.g. with relation to specific topics/ affordances/ students' characteristics and so forth). It is not just a general disposition to use ICT in a possible future, but accompanied by reasons in terms of value, potentialities or any specific possible use for ICT in teaching and learning[1].

- *Affordances of ICT*: codes considered as mentions of the possible impact perceived by interviewees in integrating technologies. These codes included the ones:
  - *Learning oriented:* with mentions of fun/attractiveness for the students; potentialities for access information on the topic (even just by visualizing it); ICT affordance in making the lesson engaging for the pupils, related to their previous knowledge/experiences, their actual interests/needs; possibilities to scaffold the learning experience and/or making the content clearer to ease comprehension; ICT affordance to make the topic or learning session meaningful to the pupils, e.g. related to their experiences/needs/previous knowledge, long term life goals, in the perspective of them growing to be critical, autonomous, responsible in their learning; potential of ICT and so forth to personalize/tailor the learning experience, according to specific needs; affordances to enable pupils to express themselves personally and

[1] As this code implies a connection in the interviewee's words among ICT value and pedagogical and/or content related issues, it was used to be merged in the analysis with the *TPCK factors* in the questionnaire.

academically; to make students active in and in charge of their learning; to enable/support/foster cooperative learning and/or address specific needs as special needs[2].

- *Teacher oriented:* with mentions of ICT being mobile, thus easy to carry; it making the lesson easier on the teacher (e.g. time saving, material saving, organizational potentialities and so forth); affordances in providing documentation repository to the service of the teacher (e.g. as material for future lessons); technology uses for controlling/disciplining students, implying a reward/punishment logic; affordances to enable/support drill and practice-based activities; and to assess students' characteristics (e.g. fulfilment of learning goals, previous knowledge and misconceptions) to the benefit of the teacher.

➢ *Lack of worth*: codes related to mentions of avoidance to use ICT in educational environment, e.g. in relation to infrastructure of schools, time-effort rate, educational worth. Included are also mentions of ICT integration as being irrelevant (e.g. the learning experience is the same with or without technologies). Moreover, the perception of ICT as being limitless in the teaching profession, so much so to eventually overcome teachers in their roles – this was attributed when the interviewee would express a lack of willingness to engage with technology integration, as inevitable in itself and out of his/her control. Finally, mentions of specific limits of ICT which would make them unreasonable to be used in education, for the interviewees: instances related to health, face-to-face communication and addressing individual learning needs.

➢ *Self-efficacy*: codes related to student-teachers reporting on their confidence about integrating ICT in teaching practices, including low confidence expressions (e.g. in terms of understanding students' needs, identifying teaching methods and implementing them, choosing topics/tools/resources) and over-esteemed capabilities (e.g. interviewees reporting of being very good at their future profession, even to the point of not needing any further improvement). Comments on the interviewees' self-confidence being founded mainly in their own past/external experiences were also considered.

Finally, to further widen the information on participants' dispositions, emerging themes related to pedagogical beliefs and attitudes were also considered. The relevant codes and families identified were (see also §B-Chp.3.3):

[2] As this code implies a focus, in the interviewee's words, on ICT usefulness in shaping the learning experience, it was used to be merged in the analysis with the *ICT impact* factor in the questionnaire.

- *Definition of learning:* codes related to interviewees identifying as main factor in learning its orientation to enter/advance in the labour market; the fun experienced by the pupil, accompanied by the need to avoid boredom as crucial point in teaching actions; the acknowledgement and active addressing of pupils feelings (e.g. students need to feel at ease all the time); the fact that enables pupils to be actively engaged in building new knowledge; its manipulative instance, implying that pupils should first and foremost use their hands to manipulate objects to learn; learning's core being it meaningful to the pupils, e.g. related to their experiences/needs/previous knowledge, long term life goals, in the perspective of having them grow to be critical, autonomous, responsible in their learning, and the attention for different media/modalities to get to this goal at best.

- *Teachers' identity:* codes related to interviewees reporting on the role of the teacher. They include the main value in teaching actions being in teachers' own happiness, entertainment, motivation; teachers' appreciation by the pupils in their person and didactic choices. Included is also the idea of a teacher with no true accountability for teaching-learning dynamics (e.g. *the topic choice is up to the National Curriculum; I don't have a choice for teaching methods, the school/pupils decide for me* and so forth), extremely prone to external pressure. Other codes are related to interviewees identifying the teacher as the one who needs to have and maintain control over the educational experience teacher (e.g. the teacher possesses all the knowledge to transmit to the pupils; learners thought as blank slates - no need to check for previous knowledge; teacher relying only on him/herself, not on external tools like ICT, and so forth). On the other end of the spectrum there are codes related to student-teachers expressing high motivation in becoming a teacher always to the service of the learners; commenting on the requirement for the teacher to be knowledgeable on the topic/methodology/resources in action, stressing a strive to professional perfection in teachers, without the need of a teacher controlling each and every part of the classroom dynamic. Finally, the comments on the idea of a teacher who reflects along the way, asking him/herself questions on teaching actions' efficacy for effective learning.

- *Pupils' identity*: codes related to the idea of learners, including expectations/assumptions on their knowledge and abilities with no reality-based examples for them; assumptions on learners being digital natives and thus technology savvy; and the idea of learners as in charge of their own learning experience, implying giving them relative to maximum freedom of choice/decision with a teacher as a peripheral helper and not main lead of the experience.

- *Pupils' individual needs consideration:* codes related to the identification and consideration of possible differences among learners. They include comments on pupils being all the same, thus making it unnecessary to address individual needs with a specific teacher action; acknowledgement of the possibility of differences in learners' characteristics (even with reference to special needs), but no further teaching action is foreseen about them, or just group work is enacted in the assumption that it will automatically solve any individual difference. Other codes relate to interviewees mentioning the need to address differences (perceived as faults) with quantity-based solutions, e.g. increasing the quantity of input without modifying it, or providing extra exposure to the teacher, in one-on-one sessions. Finally, comments on the fact that pupils' differences in learning are to be addressed with specific teacher actions: flexibility in methodologies, tailoring experiences and timeframe, adapting content and so forth.

These codes and families helped understanding how participants answered to their pre-/post-questionnaires and relevant quotations will be reported alongside the quantitative findings' description. Moreover, interviews' codes were subject to further analysis through the Epistemic Network Analysis (ENA[3]). This is a "method for identifying and quantifying connections among elements in coded data and representing them in dynamic network models" (Shaffer et al., p. 9). ENA was thus used to better visualize interview data in terms of tight/loose interconnections among codes, both within and across case studies. In this section the single cases' networks at the participants' first and second rounds of interviews will be presented.

Overall, quantitative data was used to substantiate the identification of student-teachers' characteristics and possible profiles at the beginning and at the end of their academic journey for technology integration, while qualitative data informed maps allowing the visualization of these ideal profiles with deeper information.

Third sub-question

The third research sub-question (§B- Chp.1) investigated student-teachers' pedagogical reasoning when performing TPCK-informed design tasks. These were observed twice: when participants were at their first experience with this kind of task, and after they had multiple experiences on it (i.e. two). Data was collected through focused interviews (Cohen et al., 2007) with a semi-structured protocol (§B - Chp.3.3), each one lasting 30 to 45 minutes per participant, per session.

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[3] Epistemic Network Analysis, consultable at http://www.epistemicnetwork.org/ .

Participants were given a copy of the questions in their native language[4] and in English (actual language of the interview). They could access their task guidelines (available in both languages[5]) and their design products at any time, and they might use an online dictionary of their choice, if they felt the need for it. The interviews' inquiries pertaining to this research sub-question were differently formulated in the first and second interview rounds[6]:

- **Interviews after the first design cycle**: participants were asked about their reasoning moving from their products. For example, they were asked "what was your topic? Which were the main phases in which you thought to teach this topic?". Questions were formulated in order to possibly address all the PR dimensions (Shulman, 1987; Starkey, 2010; see also §A-Chp.3[7]). Along with the factual description of their products, participants were asked *why* questions on each part of the lessons they mentioned, e.g. "why did you choose this topic? Why did you choose that teaching method?". Finally, participants were asked to state any connection between what they thought about when choosing how to create a technology-integrated learning unit, and their design task procedure. An example of this type of questions would be "would you say your guidelines ask you to modify your topic to make it more accessible to your students? How so?".

- **Interviews after the second design cycle**: participants were asked about their reasoning within a make-believe situation. They were required to imagine having to substitute a teacher in a few days, hence having to prepare themselves for it, possibly with a (non-better-specified) plan of action. The prompt questions here were "what do you need to do to make yourself ready? Is there anything you would ask the school manager? What do you need to think about?". Using the think aloud technique (Van Someren et al., 1994), interviewees were guided to clarify their decisional steps in building a learning unit[8]. Again, whenever they would mention a decisional turning point[9], a *why* question was asked, to go deeper into the interviewees' reasoning. Meanwhile, the interviewer identified in the task procedure possible items connected to the steps being alluded to by the interviewee. When the participant would state his/her satisfaction with his/her preparation for this make-believe situation, the interviewer would show the items possibly connected to what was mentioned, asking for feedback to the interviewee: "does this

[4] The translation was obtained through certified translators (Cyprus and The Netherlands cases) and a native-speaker researcher (Italy case). Each version was then revised and approved by other native-speaker researchers on the field accordingly.
[5] See also §B – Chp.3.1.
[6] For the complete protocols, please see §Appendix 2.2.
[7] As a reminder, the addressed dimensions were: *subject matter comprehension, enabling connections, teaching and learning, reflection, and new comprehension* (see also below and §B – Chp.3.1).
[8] No specific connection requirement was included about their second design cycle product: interviewees were free to decide if they wanted to implement what they just created at university (still describing how they would do so and why), or imagine a new one.
[9] In relation to the dimensions mentioned below and more in detail in §B – Chp.3.1.

item represent what you said about choosing your teaching method? How? Why?". Participants were also asked to observe the items left out, and describe if and why they would not consider those issues in creating a learning unit. Although it was not asked to rank the items, through both the issues mentioned freely by the interviewees and their feedback on the importance of the procedure's items, it was possible to understand what participants felt essential or peripheral in creating a learning unit[10].

Questions were differently formulated in order to understand more deeply both the actual student-teachers' concerns when deciding how to create a lesson plan, and the perceived connection to their task procedure.

The single case findings for this research sub-question will be presented considering both the first and second design cycles. First, the most and least mentioned reasoning dimensions will be reported, using as lens the PR adapted model already described in §B-Chp.3.1 (see Picture 0.1). The choice of using this and not the original sources was due to the reasonable expectations emerging from the first sub-question abovementioned: while any form of reasoning might have appeared in the interviews, it was in this research interest to see how likely these would reflect the guidelines' intended reasoning dimensions. It will be also reported how participants would talk about the teacher and pupils' roles[11], technology's role, and any coherence or link among the different decisional turning points mentioned. To do so, ENA for data visualization will be used. Finally, and to further approach the core of this research, it will be considered if and how student-teachers explicitly recognized a connection among their concerns and decisions when performing a technology-enhanced design task, and their given guidelines.

Picture 0.1 PR adapted model in design tasks.

[10] Later in the interview, participants were also asked to create a map with the selected guidelines' items, with the only requirement of showing connections among those. In this dissertation only on what was considered central/peripheral by the interviewees will be reported, although it would be interesting to go deeper into the analysis of these products in the future.

[11] Although these could rightfully be considered instances of pedagogical beliefs (hence considered in the second sub-question), here only factual descriptions of roles are considered, as clear intentions for action.

CHAPTER 1.
CYPRIOT CASE STUDY

1.1 SUB-QUESTION 1: TPCK INFORMED INSTRUCTIONAL DESIGN PROCEDURE AND PR REFERENCES

As described in §Section B-Chp.1, the first sub-question leading the present research investigated the TPCK-informed design procedures implemented in each case study, their bounds to ICT integration models (§A-Chp.3.1) and to PR frameworks (§A-Chp.3.2). In order to answer this question, multiple instruments were adopted: documentation (§B-Chp.3.1), participant observation (§B-Chp.3.2), and focused interviews (§B- Chp.3.3).

In the Cypriot case study, the documents made available to the researcher included: course organization institutional summary (see §b-Chp.4.1.3); task instructions and procedure with operative examples; and task evaluation rubric. All documents were available in hard copy and in the native language only[12], and they were the same documents shared with the students during classes. No access to the University course's platform was available to the researcher.

Regarding participant observation, the researcher spent 5 months in the Cypriot context (August – December 2017) and attended each lecture and workshop session of the two *Instructional Technology* courses (§B-Chp.4.1.3) addressed respectively to pre-primary or primary student-teachers, for a total of 176h on the field. During this time, the researcher assumed a non-interventionist approach, albeit physically participating in the academic events (Adler & Adler, 1994; Cohen et al., 2007). Either from a corner in the room or wandering through students' groups, she took notes through the protocols described in Section B (§B-Chp.3.2) focusing on teaching strategies and learners' responses.

For the portrayal of the academic course the reader should refer to Section B (§B-Chp.4.1.3), whereas here will be introduced the characterization of the task instructions and specific design procedure implemented in the Cypriot case study, as emerged from documentary and observation data collected.

Finally, interviews also gave some insight into how student-teachers perceived the given instructions and overall design tasks[13]. Thus, the relevant findings will be presented to give a thicker description of the design task in place in this case study (Cohen et al., 2007).

Cypriot student-teachers were engaged in two cycles of instructional design for a technology-enhanced learning unit. Their first task was to be completed in group and required the

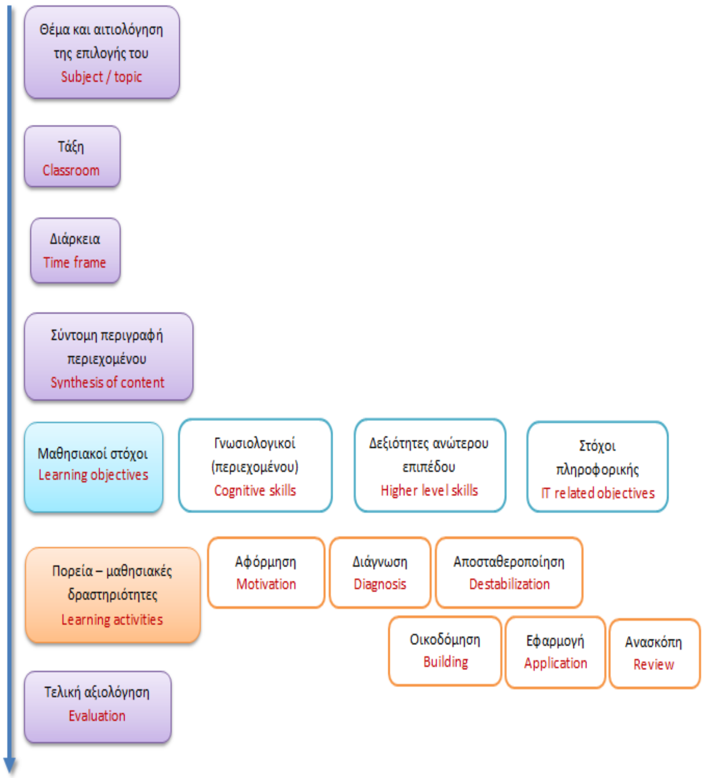
[12] As per §B-Chp.3.1, these documents were translated into English by a certified translator and then approved by their author in the translation.
[13] For the specific codes and prompt questions considered, please see Section introduction and § Appendix 2.1.

implementation of the *Kidspiration*[14] software within the design of a learning unit; the second design task was completed individually and bound to the use of a digital storytelling tool (*UTellStory*[15]) for teaching and learning (Angeli, 2017a).

The design procedure they were asked to follow is represented in Picture 1.1 in its English translation[16]. It was mandatory to use and presented the following items[17]:

1. **Topic choice →** the chosen discipline and its relation with the National curriculum (see §B- Chp.4.1.1). The list of possible topics was provided by the Professor and it excluded "natural education, the senses, psychokinetic skills and artistic expression" (Angeli, 2017b).

2. **Class →** identification of a class (age group) within lower primary or pre-primary school, according to the participant's university specialization. No further characterization was explicitly required. It was assumed that the school would be equipped with one computer every two or three pupils.



Picture 1.1 Cypriot instructional design procedure.

3. **Time →** identification of duration of the learning unit. Strongly recommended, but not mandatory, was an 80 minutes span.

4. **Topic summary →** brief summary of concepts to be taught and inner relationships among them; motivation of the choice; identification of representations and pedagogical means to be used to make the content accessible; possible misconceptions or alternative conceptions about the theme

[14] Kidspiration is a software for concept mapping targeted for K-5 learners (available at: http://www.inspiration.com/Kidspiration).
[15] UTellStory is a digital storytelling software platform (available at: https://utellstory.com/#).
[16] English translation was provided by a certified translator (§B-Chp.3.1) and accepted by the course's Professor as adequate. Picture 1.1 presents the original items' order, but for the original document format please see Appendix 11b.
[17] The information hereafter reported has its main documentary reference in Angeli (2017b), in Appendix 1.1b.

(pupils'[18] perspective); identification of the technological affordances of the software used (*Kidspiration*; *UTellStory*), that make it effective in teaching this topic.

5. **Educational goals** → identification of educational goals to be declined in cognitive/content related objectives; higher level skills objectives; ICT related objectives.

    5.1. **Content related** → identification of content related/cognitive objectives as a subcategory of educational goals.

    5.2. **Technology related** → identification of ICT related objectives as a subcategory of educational goals. In the provided examples (Angeli, 2017b), they were mainly skill related (e.g. being able to use a mouse) and/or affordance related (e.g. being able to realize a mind map through the use of technologies).

    5.3. **Higher level skills** → identification of higher-level skills objectives as a subcategory of educational goals. In the explanation provided (Angeli, 2017b), they were linked to the development of higher order thinking processes in the pupils.

6. **Lesson cycle** → description of the lesson(s) within the learning unit, for each of whom to specify which activities would take place, the learners', educator's, and ICT roles, technology's added value and use in the activities. There had to be at least 5 ICT integrated activities. Strongly recommended was a constructivist perspective on the learning process.

    6.1. **Motivation/introduction** → seen as the first phase, where the teacher should engage pupils' interests and pose issues that spark a debate on the topic.

    6.2. **Diagnosis of prior knowledge** → the teacher should diagnose pupils' initial misconceptions and previous knowledge about the chosen topic. It was supposed that pupils would be already familiar with the ICT software to be used (i.e. *Kidspiration*; *UTellStory*).

    6.3. **Destabilization of prior knowledge** → the teacher should destabilize pupils' initial misconceptions when wrong, so to then build new knowledge. Pupils should be enabled to face a challenge that ignites a cognitive conflict between what they would (wrongly) expect and what actually happens. This would be the basis for cognitive reorganization in the next phases.

    6.4. **Building new knowledge** → this was the phase in which pupils would acquire new knowledge through ICT-integrated teaching methods aimed at precise goals.

[18] Pupil is referred to (pre-) primary students to whom the instructional design product was addressed.

6.5. **Applicate new knowledge** → pupils would applicate the newly acquired knowledge in a different experience or content area so to consolidate it.

6.6. **Revision/comparison with prior knowledge** → last phase, in which there should be a summary of the core ideas addressed in the lessons and a discussion with the pupils about their initial concepts. Pupils should be guided to realize a reviewed comparison of their previous versus new knowledge.

7. **Evaluation** → assessment actions carried out in different forms, even with technology. No explicit mention/requirement for feedback practices.

As a further note, students were supported in their design process through the *e-TPCK* platform (Angeli et al., 2015), which showed completed and semi-completed lesson plans, along with metacognitive prompts. Access and active participation to the platform were mandatory for the students in both design cycles.

The two design task products were evaluated as presented in Table 1.1 (also in its English translation[19]). Each design product added up to 20% of the final students' evaluation for this course.

Table 1.1 Design product evaluation criteria – CY.

CRITERION	Maximum points
a) Theme and motivation of the adequacy of Kidspiration for teaching the topic	5
b) Short description of content	5
c) Objectives	5
d) Activities	(35)
1. Motivation/description of interest for the learners	5
2. Identification of pupils' initial conceptions	5
3. Destabilization of misconceptions	5
4. Construction of knowledge (expressing, exploring, making decisions, collaborating, discovering, and so forth)	10
5. Application of knowledge	5
6. Comparison of initial ideas with new ones	5
e) The added value of software in learning activities	10
TOTAL	60

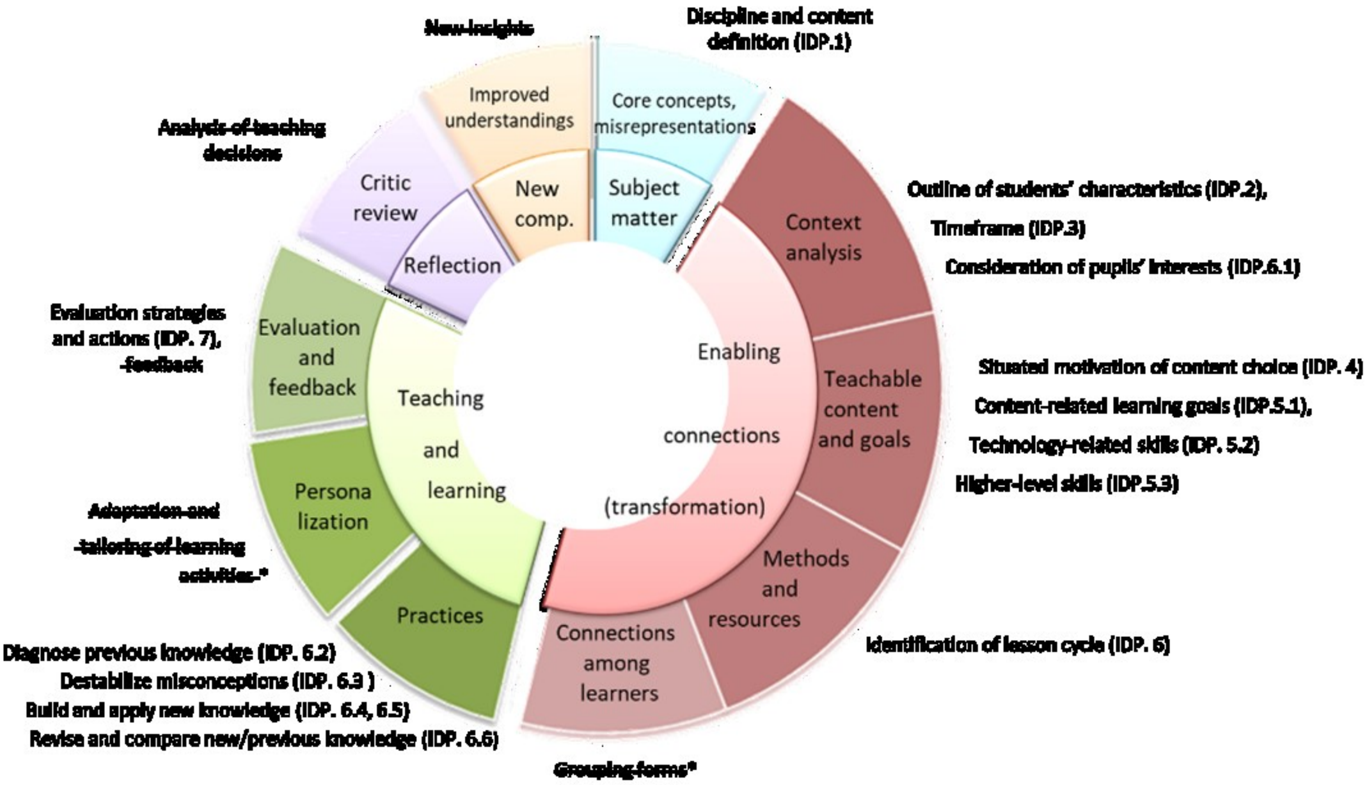
[19] English translation was provided by a certified translator (§B-Chp.3.1) and accepted by the course's Professor as adequate. Table 1.1 reports the original order of the rubric's components while for the original document please see Appendix 1.1c.

As for the theoretical foundations of the Cypriot design task procedure, it can be detected a clear alignment with the *ICT-TPCK* framework for teacher knowledge (Angeli & Valanides, 2009) and with *Technology Mapping* as approaches to technology integration in education. ICT-TPCK (see also §A-Chp.1) is conceived as the unique body of knowledge that makes a teacher competent to design technology-enhanced learning (Angeli & Valanides, 2009) in which the core is a transformative understanding of how particular topics may be difficult to be learned/taught and can thus benefit from ICT use as cognitive partner. References to ICT-TPCK can be found in the importance given, within the task, to pupils' misconceptions and misunderstandings, core to teaching actions (e.g. IDP[20]. 4, IDP. 6 - Table 1.1). Furthermore, as reported by Angeli & Valanides (2009), ICT-TPCK realizes socio-cognitive constructivist ideas[21] creating powerful understanding transformations by sparking (socio) cognitive conflicts and encouraging negotiation of meaning among pupils' different conceptions (see also §A-Chp.3.1.3). Once again, this can be found mainly in IDP. 6 and sub-components, where technological and not technological means are used to elicit and transform pupils' previous knowledge in expert one.

The specific role of technologies within such ICT-TPCK design process is strongly related to the *Technology Mapping* approach (TM – Angeli & Valanides, 2013). TM is deemed as a process through which teachers institute connections among tools' affordances, content and pedagogy, in relation to learners' content-related difficulties (Angeli & Valanides, 2013). This approach, meant to be a resource for teachers dealing with technology in design problems (Angeli & Valanides, 2009), was explicitly referred to by the course professor and the lab teacher when introducing the design tasks. Furthermore, TM's realization can be found in the strict requirement of using a specific digital tool to complete the design task (namely, *Kidspiration*, first, and *UTellStory*, later). Student-teachers were thus expected to find suitable technological affordances for the identified pupils' content-related misconceptions. Furthermore, it is to highlight the great importance given to the demonstration of "added value of software in learning activities" (Table 1.1) when assessing the design products, as proof of "mapping tool affordances onto content and pedagogy" (Angeli & Valanides, 2009).

[20] Instructional Design Procedure, IDP acronym will be hereafter used to refer to the procedure's items.

[21] Explicit reference to this learning theory was in the heading of the design task instructions, given to the student teachers during the course.



Picture 1.2 PR model in design task procedure - CY.

Along with such theoretical ground for technology integration informing the task, any reference to reasoning models was sought, as for the research inquiry at stake. Considering the adapted PR model described in Section B (§B- Chp.3.1) as lens for data analysis, it was sought to identify any overlap with the Cypriot design task procedure's items (Picture 1.2).

The possible attribution of the item to the PR dimension was made according to the former's definition within the instructions given to the student-teachers. The item *Lesson cycle* (IDP. 6) and sub-components (i.e. IDP. 6.2-6.6) could have been attributed either to *selection of methods and resources* or to *classroom-based practices*. Whereas the completion of those items would entail decisions dealing with selecting teaching approaches, methods and resources for learning, they were to be expressed in the form of realistic classroom-based activities. The *lesson cycle* (IDP. 6) section of the design task required student-teachers to clearly focus on technological affordances and added value to the learning experience. Given these premises, decisions related to practically connect naïf and new knowledge though specific methods/resources (IDP.6.2-6.6) were attributed to the *teaching and learning* reasoning dimension, while the decisional steps to identify the overall instructional organization (IDP. 6) were attributed to the *transformation* reasoning dimension.

Some reasoning dimensions were not detectable in specific items (e.g. *connection among learners* and *personalization*), but were indeed suggested by the instructors explaining how to complete the design task. In the design product examples provided to the student-teachers during the course (§Appendix 1.1b), grouping forms and instances of tailoring of the teaching experience were presented, while the underpinning socio-constructivist perspective characterizing the task would have pressured towards the consideration of those issues. Nevertheless, as they were not explicitly required by the procedure items or its evaluation rubric, but pertaining a more subjective interpretation of the task, caution should be use in attributing them to reasoning dimensions.

Finally, three reasoning issues are apparently neglected by the Cypriot design procedure: *feedback practices, reflection* and *new comprehension*. While the first one was not explicitly addressed even in other materials or course lessons (to the researcher's knowledge), the latter two were detectable in the course Professor's evaluations of design products. Formative evaluation was given by the Professor during lecture course sessions[22], possibly sparking informal discussions among student-teachers. Given these blurry conditions, it could not be set a clear and solid connection between the design task procedure and the *reflection* and *new comprehension* reasoning dimensions on the student-teachers' side.

To better answer the research question on procedures' connection to pedagogical reasoning for technology integration, how such tasks and procedures were understood by student-teachers was also investigated. During focused interviews (N. 30[23] – see §B- Chp.3.4), participants mentioned instances about:

- *Familiarity of the procedure*, useful to investigate possible previous experiences with a technology-enhanced design that might influence this task's performance.

  Whereas no interviewee said that the given procedures were similar to any other previously used at university (or elsewhere), just four student-teachers expressed high difficulties in performing the task due to its novelty, and only in relation to the first design cycle (e.g. "we thought that we wouldn't be able to do this because it was [the] first time we had to do something like that" – CY8a[24]; "[I felt like] I'm drowning, it was my first experience" – CY3a).

  On the other hand, after the second design cycle, eight students mentioned being quite comfortable with the guidelines by that time (e.g. "[it] was clear and the second assignment was like the first one so at that time I was more ready" – CY7b). This last finding anticipates slightly the next point about the actual use of the given guidelines (ideally mandatory).

[22] It is to highlight that, while the course was mandatory (see §B- Chp.4.1.3), attendance was hardly ever of 100%.

[23] As the reader might recall (§B-Chp.3.3, B-Chp.4), interviewees were 18 after the first design cycle and 12 after the second. A nineteenth interview after the first design cycle was discarded during data analysis due to low content reliability.

[24] Due to privacy reasons, participants' names will be masked at all times. They will be referred through the belonging case's acronym (CY, IT, NL), a number, and the letter "a" if it was the first interview (after the first design cycle) or "b" if it was the second interview (after the second design cycle).

- *Relevance of the procedure*, analysed to understand if the student-teacher actually used the given guidelines in performing the task or relied on other resources (e.g. pre-made materials, past experiences and so forth).

  Four interviewees claimed they did not rely on the guidelines to carry out the design task (just in the first cycle), preferring suggestions from internship experiences (e.g. "[in real classrooms] we actually watch the teacher teaching kids and stuff, so this is actually helpful because it's practical and you can keep notes about what they have to do or not to do" –CY11a); or personal inclinations (e.g." I made a plan on a piece of paper I thought 'I want to do this and this and this', I wrote my motivation… so I knew how to plan it and then I started writing" – CY10a).

  This also gave some insight on a *performance orientation* of the interviewees, which might have fostered passive execution over active reasoning. Only a few of them expressed a slight performance orientation (three in the first cycle, two in the second), with instances as: "we have not so much time because we have other classes to work, these assignments […] will be something that needs time"(CY10a); or "[was difficult] the UTellStory this program you have to know to do a story on that, it's not just take some pictures put them in an order and you make a story" (CY6b).

- *Understanding of guidelines*, considered to identify the main perceived difficulties in comprehending and performing the design task.

  Guidelines were perceived as unclear by seven student-teachers, during the first design cycle, but as familiarization increased just three interviewees mentioned difficulties in the second interview. Instances reported, for example: "I wouldn't say I fully understand the instructions because the way she writes things it's a bit confusing" (CY10a), or "I was very confused because this time we had to do the story…we thought this assignment is about only the story but then I understand that the same thing as Kidspiration" (CY5b). When facing difficulties, interviewees reported having asked for support (respectively ten and five in the first/second interviews): "we went to her office once and after we have done some research and we found our subject and we went to talk with her and then she helped us" (CY6a); "I asked the professor and then my friends…we talked about the assignment we have to do" (CY16a). Some, albeit just a very few, would have appreciated still further support ("I wanted more explanation of course in the class" – CY12b), or thought the needed support would have to be found elsewhere ("I had to make an assignment about what I'm going to teach [i.e. math lesson], and because the professor […] she's not a mathematics professor, she can evaluate my assignment [up to a] point" – CY11a).

Overall, the main difficulties were reported on completing IDP.6 and sub-components, in relation to items' implications ("we find most difficult the constructing knowledge because we don't know what we do there" – CY14a); to lack of field experience ("[the most difficult part] was applicate new knowledge, because it is difficult if you don't have kids in front of you, to think about what to [do], what will you make to see if they understand you or want to learn this" – CY4b); or to technology integration (e.g. "It was difficult to do diagnosis and destabilization and the building new knowledge with Kidspiration, it was difficult to find activities with Kidspiration" – CY16a; "most difficult was the constructivism [referring to part 6] because we have the technology as a new point in the assignment and because our lesson it was the first time that we try to do it" – CY6b).

- *Technology integration requirements*, investigated to see how this issue was perceived by the student-teachers in relation to the procedure's conditions. Integrating technologies in the design was problematic for eight interviewees at their first attempt, mainly because of the specific requirement of using *Kidspiration*: "the difficulties we found were with the activities with Kidspiration because we didn't know how to organize them to make them look like…to be based on the constructive way of learning" (CY8a).

  Four of the student-teachers claimed similar difficulties even at the end of the second design cycle with UTellStory, for example: "[it] was more easy that it wasn't necessary to include in our assignment technology in all exercises, only in building new knowledge" (CY2b); "the second tool was much more difficult than the first one for me" (CY4b); or "[it was] for different children age so yes, it's difficult to decide what to do and how…especially with a digital story" (CY9b).

- *Overall worth of the given procedure* as effective guidelines for designing a technology-integrated learning unit. Just a few interviewees (two after the first design cycle, one after the second) mentioned they would not consider these instructions valid commenting, for example: "it's a lot of work and I think that if you have technology on your daily basis you will have experience on it, how it's best for you to use and integrate it in your classes, instead of following a plan every [time], I'm not a fan of a strict plan" (CY14a).

  Others would find some worth in using the given procedure only under specific circumstances, for examples "sometimes I might follow the structure, sometimes I might not. It depends on the class though. […] Some of the kids, they don't know anything about things [referring to previous knowledge] because some kids might have computers in their house, others not, they might only get through the mobile phones of their parents…it's not the same thing" (CY18a); or "I think I will use these, not in every lesson but in the topics that I won't find it easy to find some activities or something, I will have on my mind that I have Kidspiration or UTellStory that I can use" (CY8b).

Finally, several student-teachers (12 and 10 respectively after the first and second design cycle) attributed high worth to the guidelines and would use them again, either for any design or specifically for technology integration: "I can say I agree because they have a logical sequential order" (CY 5a); "this strategy [i.e. procedure] helps students to build their own knowledge about the subject that they used to have a different knowledge about it" (CY 17a) ; "[one should use them] because otherwise you're missing something and it's not a complete lesson" (CY7b); "this is very helpful because she gave us step by step what we have to do to continue building new knowledge and using constructivism and technologies to do it" (CY 10a); "when I think about technology lessons I think this one and not the other lesson plans that I have learned through the university years" (CY1b); "through technology we learn how to…about this model eh how to build new knowledge, we have clearly the steps and the way that we have to create it so these two are connected I think" (CY 7 Post).

These findings are relevant to the first research sub-question (§B- Chp.1) as they help understanding intended and perceived connections between the implemented design procedure and the pedagogical reasoning for technology integration theoretical models. Moreover, this information helps in answering the main research question because it sets a situated background of references to interpret data on reasoning manifestations (§Chp.1.3). From the findings reported here, the given design procedure would seem to have had clear theoretical foundations for technology integration, transparent even to the student-teachers, who would use the same lexis to refer to the design parts. While it was indeed new to the participants, posing some issues in understanding the specific parts and complying to the integration of the required technological tools, the majority of student-teachers recognized in the procedure valid guidelines for TPCK-informed design practices. These premises, and the overlap found between the procedure's items and most of the PR model dimensions, pose as a ground of interpretation for actual participants' reasoning manifestations and their relation to the used procedure (§Chp.1.3).

1.2 SUB-QUESTION 2: STUDENT TEACHERS' DISPOSITIONS TOWARD ICT INTEGRATION

The second sub-question leading this research investigates student-teachers' dispositions towards technology integration (§B- Chp.1). These were observed twice: when participants were just starting to deal with the issue (i.e. at the beginning of their university course and at their first concrete attempt to design with technologies) and when they had multiple experiences on it (i.e. at the end of their course and after yet another technology-integrated design cycle). In this mixed method section within the wider research (Creswell, 2013), the implemented instruments for data collection were a pre-/post- questionnaire (§B- Chp.3.4) and focused interviews (§B- Chp.3.3). Data were collected independently in the 5 months-time-span spent in the Cypriot context, then merged when interpreting the results (parallel convergent mixed method – Creswell, 2013).

In the next paragraphs the Cypriot findings will be reported, as emerging from the quantitative and qualitative instruments according to the specific research question. First, it will be shown how participants' dispositions towards ICT integration were characterized at the beginning of their academic journey on this issue, presenting the overall population and a typical student-teacher. Then, it will be described how these dispositions changed after multiple experiences with TPCK-informed design tasks, for the Cypriot student-teachers.

AT THE BEGINNING OF THE ACADEMIC JOURNEY FOR TECHNOLOGY INTEGRATION

Considering the pre-questionnaire data (5-point Likert scale), Cypriot student-teachers beginning their academic course appeared overall open and positive to the possibility of integrating ICTs in educational practices[25]. As per Figure 1.1, participants expressed quite high measures of comfort and ease in using technologies (*enablers*[26] $\bar{x}= 3.9$, $\sigma= 0.4$), accompanied by fairly low measures of stress and avoidance (*barriers* $\bar{x}= 1.9$, $\sigma= 0.6$).

[25] The presented findings pertain to the pre-questionnaire, answered by 113 participants.
[26] As per §B- Chp.3.4, questionnaire's factors *enablers* and *barriers* included respectively indicators of comfort, ease and likelihood to use technologies in everyday practice, or to the contrary stress, frustration and difficulties in doing so.

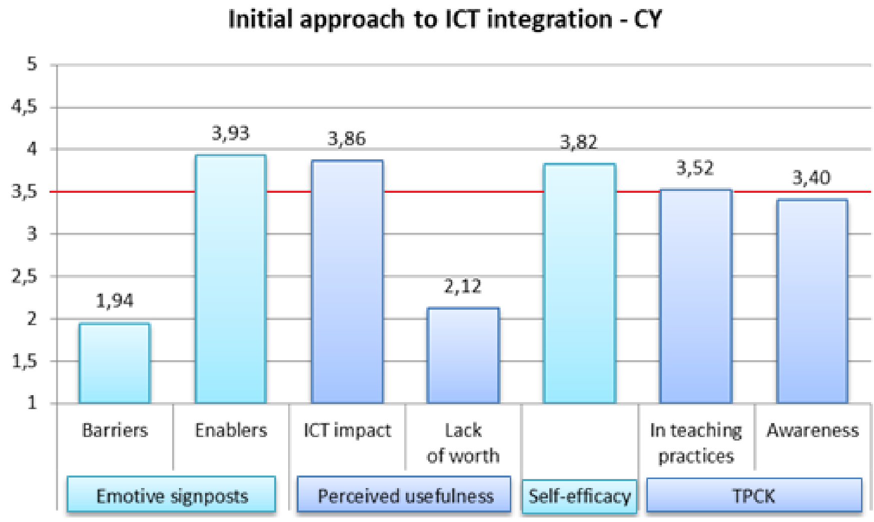


Figure 1.1 Pre-questionnaire measures for dispositions towards ICT integration - CY

Briefly anticipating the qualitative findings, a couple of interviewees' quotes on this point: "I like using technology, I am a person that uses technology every day in my life" (CY1a); "I really like to work in the computer and find stuff so I think it will not be any problem I mean every program has its difficulties, you just have to adjust" (CY3a). On the other hand, some of the less positive would say things like "I am not a very technological person" (CY10a); "I don't have patience with this program [i.e. Kidspiration] so I just make my colleague deal with it" (CY14a).

Cypriot student-teachers would also perceive fairly well the potentialities for ICT use in teaching and learning, as by the high score reported on the *impact* ($\bar{x}$= 3.9, σ= 0.5) and the fairly low one on its ideal opposite: *lack of worth* ($\bar{x}$= 2.1, σ= 0.6). Again, some example from the interviewees' words: "we can't see bees and how is it their days or how they make honey, and it's difficult to understand if you don't see them in real life. So Kidspiration was an easy way to teach about bees" (CY4a); or to the contrary: "it's difficult to make an argument [i.e. address a topic] for me in front of a pc, it's more with discussions, exercises… not in pc" (CY2a); "first of all there are not many computer in the class [so I do not really see the point]" (CY15a); "the technology in class is not very realistic" (CY14a).

Even the *self-assessed capability* in selecting, integrating and assessing the use of ICT in education scored on the high end of the scale ($\bar{x}$= 3.8, σ= 0.6), suggesting a good level of confidence in student-teachers at the beginning of the university course. Its roots, in the interviewee's words, are usually related to internship experiences (e.g. "we went to school several times so we kind of know what's going on with the teaching thing" - CY11a).

Finally, Cypriot student-teachers' perception of their own TPCK at the beginning of the course scored just above the average, in relation to both the *awareness* of possible content-pedagogical technologies ($\bar{x}$= 3.4, σ= 0.6) and to their actual *practical integration* ($\bar{x}$= 3.5, σ= 0.6).

As the interviewees would say: "I think that every subject is suitable to use technology, but you must find the point of each subject" (CY6a); "I [think] generally the technology doesn't give chances to all the kids [to] take part [in] the learning process" (CY8a); "every time we had in mind that 'ok it's very useful for the children to use technology because they are interested in technology', but it's not the only way, actually, because they can do it other ways anyway [so you need a stronger reason]" (CY9a).

Going a little deeper with the quantitative data analysis, some patterns could be identified in student-teachers' answers to the pre-questionnaire and thus were able to detect different profiles (§D- Chp.2). The one most grounded in the Cypriot context, i.e. the one who gathered the most respondents, was the one renamed Chara[27] (see Table 1.2 and Figure 1.2).

Chara is likely a 17-22 years old student-teacher, with an average appreciation of *university equipment* and *encouraging actions* (mean scores on these areas[28] were 3.3-3.5 out of 5 on the Likert scale). She is somehow familiar with *lower order digital applications and software* ($\overline{x}$ =3.2), but not so much with the *higher order* ones more specialized for the educational context ($\overline{x}$= 1.6). She is also keen on *surfing the internet* to explore web-based technologies ($\overline{x}$=4.4)[29].

Albeit Chara's dispositions towards ICT integration are distinctive in relation to other types of student-teachers found (see Table 1.2), they are not so different from the Cypriot means' on the issue (see Figure 1.2) and to no surprise: Chara ideally represents the 46% of the Cypriot student-teachers responding to the pre-questionnaire.

Table 1.2 Chara's profile in relation to other student-teachers' profiles – CY.

Factor	Mean	Sig.*	Cohen's *d**
Emotive barriers (stress and avoidance)	2.18	.000	≥.65
Emotive enablers (comfort and openness to use)	3.65	.000	≥.96
Impact of ICTs on teaching and learning	3.71	≤.001	≥.51
Lack of worth of ICTs in education	2.29	.000	≥1.4
Self-efficacy	3.8	≤.001	≥.76
TPCK in teaching practices	3.22	.000	≥1.03
TPCK awareness	3.32	.000	≥1.49
* These measures refer to the statistical significance and size effect of this profile's distance from others. As there were overall four different profiles, if manifold, the bigger (for significance) and smaller (for Cohen's d) values are displayed.			

[27] This is a fictional name and any resemblance to real events and/or real persons is purely coincidental.
[28] As the reader might recall from §B- Chp.3.4, the questionnaire's factors related to this topic are: *Surrounding encouragement* (α = .79), *University equipment* (α = .83), and *University's active role* (α = .92).
[29] These background measures are fairly similar to the ones of the overall Cypriot population (see §B-Chp.4.1.4).

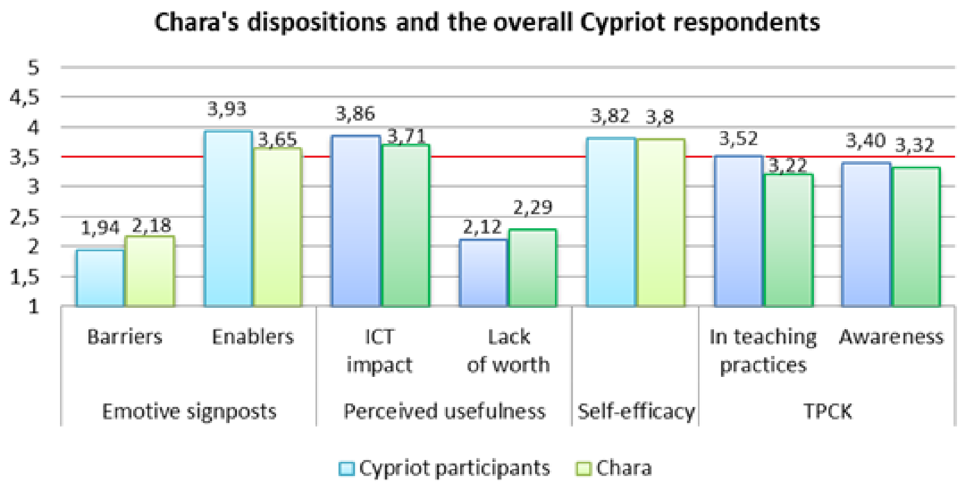


Figure 1.2 Chara and Cypriot respondents' scores for dispositions towards ICT integration (means).

Chara's characteristics, so close to the overall Cypriot participants' and yet not exclusive to this case study, will be further analysed in §D – Chp.2 within the cross-case perspective.

Finally, to take the maximum advantage from the mixed method approach to this matter of inquiry, a multidimensional scaling was carried out on the pre-questionnaire data (Figure 1.3), while first-round interviews'[30] codes were mapped through the Epistemic Network Analysis software (ENA – Figure 1.4). They will now be observed together, focusing on clusters of items and codes, as in both analyses distance indicates difference in the items/codes' roles in shaping the answer/discussion (Kruskal & Wish, 1978; Shaffer et al., 2016).

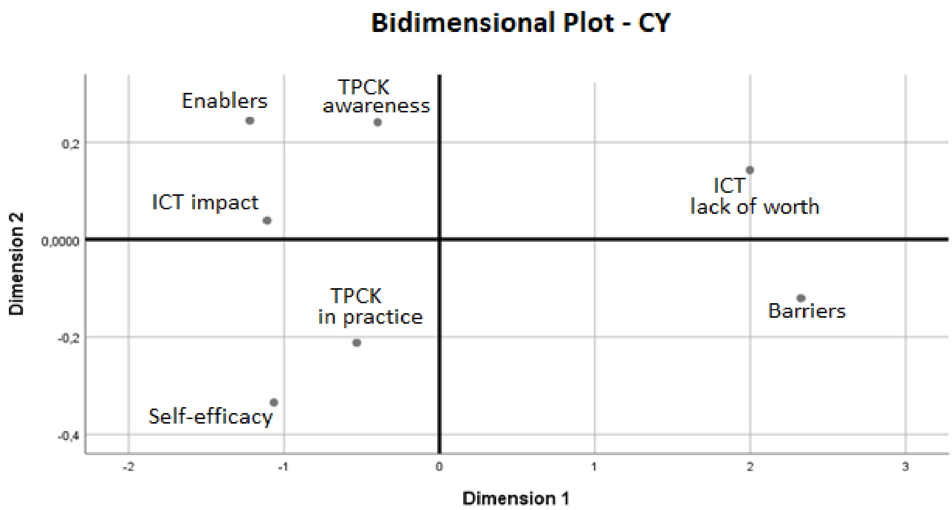


Figure 1.3 Cypriot pre-questionnaire respondents' dispositions (multidimensional scaling, N=113).

[30] N=18.

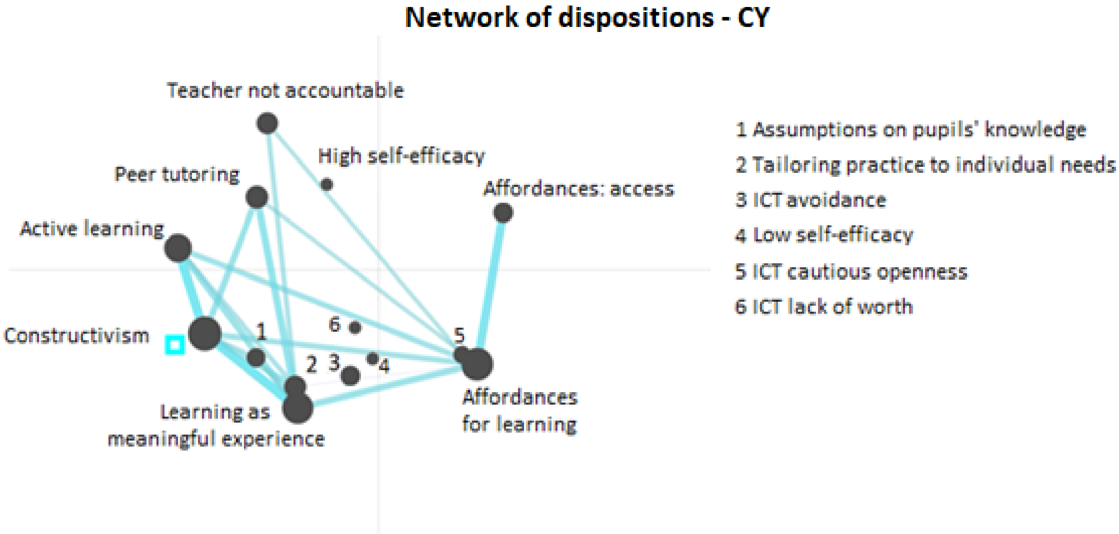


Figure 1.4 Network of dispositions - CY first interviews (connections among codes, N= 18).

It is immediately clear by Figure 1.3 how *emotive barriers* and a perception of *lack of worth* of technologies in education stand on a very different ground from *emotive enablers* and the perception of *impact of technologies* in the learning experience. The same clustering and contraposition could be retraced in Figure 1.4, where *ICT avoidance* (3) and *ICT lack of worth* (6) are in the same area of the discussion network, quite far from *ICT cautious openness* (5) and codes for *affordances for learning* (considered as indicator of technology impact[31]), which in turn are almost overlapping.

Furthermore, *self-efficacy* in Figure 1.3 joins closely the measure of *TPCK practices,* suggesting a possible correlation between the two in the minds of the respondents. In Figure 1.4 instances of *low self-efficacy* (4) are close to the negative approach to ICT in education: *ICT avoidance* (3) and *ICT lack of worth* (6). On the other hand, comments of *high self-efficacy* are far from this area, closer to *peer tutoring* instances and, surprisingly, to *not accountability of the teacher* (although the two codes are not connected).

Moreover, through the ENA software was possible to explore not only said role of the codes in shaping the model, but also their weight (the codes' frequency can be retraced in the size of the dots) and the connections. This way, it can be noticed that *emotive barriers* and *self-efficacy* were not significantly connected to the other codes[32], whereas mentions of *affordances for learning* (as *ICT impact*) and *cautious openness* (5 - as *emotive enablers*) were. Mentions of technologies'

[31] This code accounts for all the instances related to technological affordances to: *engage* pupils in the learning experience (appealing to their previous knowledge/experience); *scaffold* and/or *improve comprehension* of the topic; provide a *meaningful learning* experience (i.e. tailored to pupils' interests and needs, in a long term perspective to improve critical thinking, learning autonomies and responsibility); enable *active learning* and/or *cooperative learning;* and to address/*compensate* specific needs of the students. As perceivable, all these instances share a focus on the concrete uses of technologies and their consequences within the learning process.

[32] It is to highlight that for analysis and visualization purposes, ENA minimum threshold was set at 0.3, showing only the strongest connections among codes, relevant for the whole population of interviewees.

affordances for learning were strongly related to the ones for content *access,* and more lightly to the creation of *meaningful learning experiences* within a *constructivist* educational perspective. Examples of this may be "[I think that you should use technology to] make so that the students would make something out of it and not just be on the computer and play, but make them learn and build the new knowledge" (CY3a); "the kids [can] visualize each concept, they can construct knowledge in steps and they can visualize every term, fraction, bigger, smaller, and this is important" (CY1a); "[I think] it's easier for them to learn by using technology [because they are digital natives]" (CY9a); "I think that technology it's useful or make the lesson more amazing for the children because it's hard for them to be in the chair and listen, listen, listen, they have to make them to do things and technology is something that they have in our day at home" (CY10a).

The *cautious openness* (5) showed by interviewees for technology integration was surprisingly connected to both an idea of learning through *peer tutoring* (e.g. "because in Cyprus we don't have a lot of computers and iPads or something so you want them to cooperate with others" - CY16a) and of teacher as *not accountable* for the educational experience (e.g. "today children they're using technology from the time that they are born, so of course they want me to [use technologies]" – CY1a). *Cautious openness* (5) code accounts also for specific interviewees' resistances in adopting technologies at this point in time, mostly related to school equipment "[I would like to use technologies but] it's difficult to find a classroom that have a computer for all, and this is the reason [I am sceptical]" (CY2a); or pedagogical beliefs "I like to integrate technology, but […] especially in the pre-primary [level], it wouldn't be my first choice, they're too small to understand" (CY10a).

Other meaningful connections (shown by the thickness of the lines among dots in Figure 1.4) are the ones from *constructivism* to *active learning* and the idea of *learning as a meaningful experience,* which is close to the value attributed to *tailoring practice to individual needs* and connected again to *peer tutoring* comments. Examples of this part of the network would be: "[for the teacher to be] just standing in front of them [i.e. pupils] and telling them [the content], they will not consider it or not think, give it so much thought that could be needed, they need to be active in building their knowledge […] [to] start asking questions so that they can start doubting what they said and everything" (CY3a); "students start to make some hypothesis […] and I try to make them think why it's happening and they discuss in groups" (CY6a).

Finally, the centroid of the discussion (little square in Figure 1.4) would suggest that the *constructivist* dispositional horizon for education is at the core of the whole model of Cypriot student-teachers' first round interviews. This might suggest that the interviewees were really engaged in pedagogical beliefs entailing educational experiences tailored to pupils' characteristics and their active role in the construction of knowledge within social and individual dynamics.

After multiple academic experiences for technology integration

The present research was also interested in how student-teachers would describe their dispositions towards ICT integration after multiple experiences with TPCK-informed instructional design and the completion of the germane university course (§B-Chp.1). In the following paragraphs findings will be described moving from the post-questionnaire and the qualitative evidence gathered on the topic after the second design cycle, in the Cypriot case study.

An ANOVA on the pre- (N= 113) versus post- questionnaire (N= 93) suggested that in the latter Cypriot student-teachers scored significantly different in two areas, namely: *knowledge of higher order digital applications and software* (*p.* .000, *d* = 1.2); and *TPCK in teaching practice* (*p.* .01, *d.*= .4 – see Figure 1.5). The mean for the first factor increased substantially from $\overline{x}$=1.7 (σ=.52[33]), to $\overline{x}$=2.4 (σ=.69) and the large size effect suggests that respondents rate themselves more familiar with educational technologies' use, albeit the final score still figures on the low end of the scale. This is not strictly a dispositional factor, but nevertheless accounts for some changes possibly fostered by the academic course and design experiences occurred, which included at least the exposure to digital educational tools.

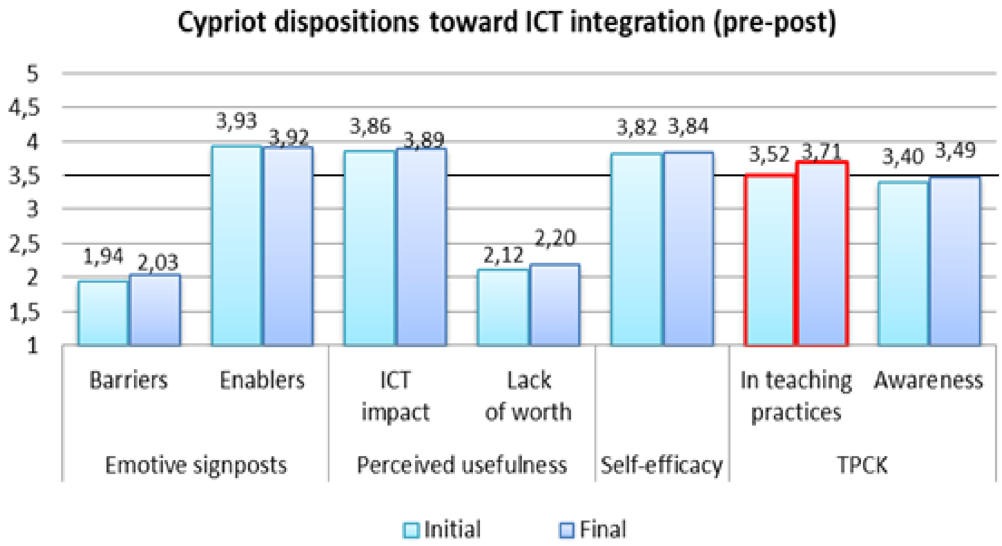


Figure 1.5 Cypriot participants' dispositions in the pre and post questionnaires (means).

[33] For the initial scores on the Cypriot *knowledge of ICT use*, *access* and *contextual support appreciation*, please see §B-Chp.4.1.4.

When analysing *TPCK* as *practical* integration of pedagogy, content and technology, Cypriot student-teachers increased their self-assessment from $\bar{x}$=3.5 (σ= .57), to $\bar{x}$=3.7 (σ =.51), with a mild size effect (*d.*= .4 – Cohen, 1988) still within the range of the desired effects for educators (Hattie, 2009). Thus, it can be considered meaningful the even slight improvement in participants' perception of capability to enact content – based, pedagogically – oriented, technologically – integrated practices, moving towards the higher end of the scale.

On background measures, no significant differences were scored on the areas of perception of *contextual support*, *knowledge* of and *access* to most *common technologies* or the *internet*[34]. Overall, even changes in *emotive signposts* and perception of ICT usefulness (*impact* and *lack of worth*) were not significant. At the end of the course, after multiple experiences with TPCK-informed design tasks, Cypriot student-teachers still felt quite comfortable (*enablers:* $\bar{x}$= 3.9, σ=.53) in using technologies in education, getting just mildly stressed (*barriers:* $\bar{x}$=2.0, σ=.61) by it. They perceived the many potentialities in ICT educational uses (*impact:* $\bar{x}$=3.9, σ=.49) albeit a little scepticism remained (*lack of worth:* $\bar{x}$=2.2, σ=.67). Their overall *self-efficacy* persisted to be quite high ($\bar{x}$=3.8, σ=.57), and the *TPCK awareness* maintained a mean score just slightly above the middle of the scale ($\bar{x}$=3.5, σ=.65).

Interestingly, from the qualitative data emerges that six student-teachers interviewed, after both the first (N=18) and second (N=12[35]) design-cycles, would explicitly mention being meaningfully more confident in and open to integrate technologies because of the course and/or experiences with the design task: "it's the first time that someone […] teach us about teaching programs [i.e. educational technologies] so I started thinking how I can use technology in my lessons" (CY 16a); "now that I have had these lessons this semester I think I will use [ICT] more interactively with students" (CY1b); "now I understand a lot of things with this subject [i.e. ICT integration], I learned new things. [...] I am scared less than before because now I practiced with some technology" (CY2b); "when we started I was afraid of use technology but now I have learned how to use technology so it's much easier" (CY4b); "[when] I have to think some activities [...] now I think also about technologies...two months ago, I wouldn't think about technology" (CY8b).

Whereas several of the single factors' means did not significantly change, as described, something changed in the patterns of answers of the participants. In fact, when looking for Chara, it appeared that she was not the typical Cypriot student-teacher anymore, as a discriminant function

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[34] Once again, for the initial scores on the Cypriot *knowledge of ICT use*, *access* and *contextual support appreciation*, please see §B-Chp.4.1.4.

[35] N=12. Every participant to the second-round of interviews participated also to the first-round (N=18). In this dissertation it was chosen to consider the whole population of interviewees for both rounds of interviews, so to have a richer description of the phenomenon in the context (Cohen et al., 2007; Stake, 2006). Non parametric comparisons through ENA between the 12 two-time interviewees and the 6 one-time interviewees for the first round of interviews showed that the two samples were not significantly different in terms of dispositions' codes. Hence, the 12 two-times interviewees are to be considered eligible to give as relevant data as the 18 first-round ones.

analysis on that very clustering strategy would result correct only for 19.8% of the post-questionnaire respondents[36]. To further investigate modifications between the beginning and the end of the student-teachers' academic journey for technology integration, multidimensional scaling and network analysis were used once again.

It will now be observed the post-questionnaire multidimensional scaling (Figure 1.6), and second-round interviews' codes mapped through the Epistemic Network Analysis software (ENA – Figure 1.7), in terms of clusters of items and codes, and modifications through time.

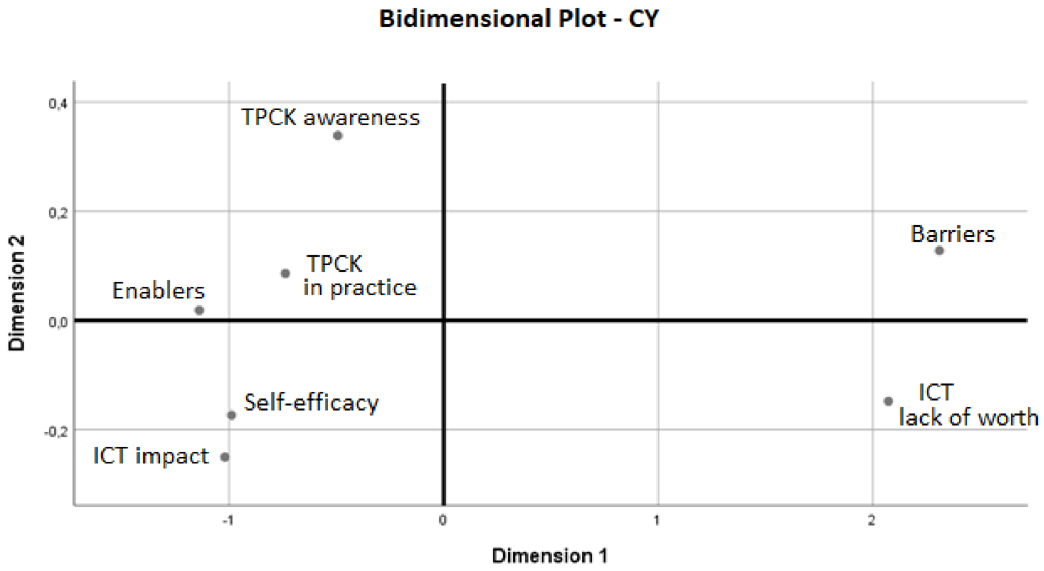

Figure 1.6 Cypriot post- questionnaire respondents' dispositions (multidimensional scaling, N= 93).

Figure 1.6 shows already some interesting modifications in Cypriot responses, as measures of *TPCK awareness* and *practice* are now nearer than before, the second now much closer to *enablers* than the first one is. Moreover, the perception of *impact* of technologies moved to be adjoining *self-efficacy,* possibly suggesting that the two are more related in the respondents' mind than before. *Emotive barriers* and the perception of *lack of worth* of technologies are still far from anything else, at the end of the university course.

[36] For further details on this analysis and the emerging new profile of respondents, please see §D – Chp.2.

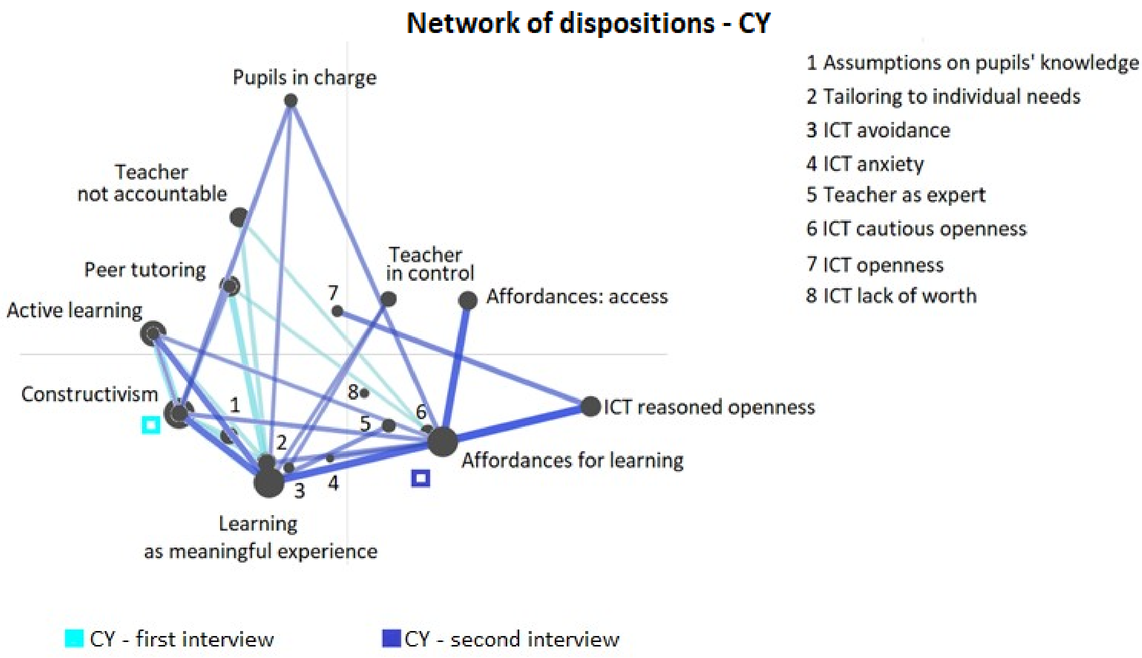

Figure 1.7 Network of dispositions - CY first and second interviews (connections among codes).

A similar negative nucleus could be found in Figure 1.7, where *ICT avoidance* (3), *ICT anxiety* (4) and *ICT lack of worth* (8) are somehow gravitating around the same network area. Moreover, their dots are smaller than before, indicating a lower frequency. More positive indicators like *ICT cautious openness* (6) and *affordances for learning* (as indicator of perceived *impact*) maintain close relationship, the second increasing in mentions too. Furthermore, the second-round interviewees would make less comments on the *constructivism* perspective for learning, or the *active* role of their pupils, but would indicate new issues like *ICT openness* (7) as positive approach to integration not linked to any resistance (as *cautious ICT openness*), although not as specific as the also new *ICT reasoned openness* which could be interpreted as *TPCK* related disposition (e.g. "we don't know about our heart pumping o the blood, for example, so I think technology makes me teach to students something that they cannot see in real life and understand better and maybe it's something that it's more engaging than only [the teacher] speaking" – CY2b ; "I think technology is very useful in helping kids and especially in Kindergarten because kids they don't understand very easily the lesson, so with images and activities with technologies they can understand better" – CY4b; "now I found that it's not only interesting [to use technologies] but they [i.e. pupils] can organize their thoughts better, and also the time that they spend [to understand] is less, because they have the skills [as they are digital natives] so we have to use these skills in our lessons" – CY7b; "I think they [i.e. technologies] can solve some issues and problems that maybe you have in your classroom, maybe you have children with special needs…because for them maybe what I believe it's easy maybe for them it's not so I want to incorporate technology to help them understand better" – CY9b).

Moreover, teachers' *not accountability* seem to have lost its weight in the second round of interviews, while a new idea of teacher arises: one who is *in control* of the learning experience, although inclined to make it *meaningful* and *tailored* to children's needs (e.g. "you have to find something that is interest for the kids to make them listen and focus on you and what do you want to tell them" – CY4b). New attention for the role of pupils in education also emerges in the second round of interviews: *pupils in charge*, indicating a student-driven learning experience (e.g. "it's important for the [pupils] to realize 'ok I know 3 things until now, I'm going to build on them' " – CY11b; "you don't want to just tell them the answer because they are going to the end and maybe they will not understand the [process] so you do to a different approach and make some efforts that they will understand by themselves" – CY3b).

Finally, the centroid of the whole discussion (dark blue square) moved towards *affordances for learning.* This might suggest that the interviewees were really engaged in pedagogical beliefs entailing educational uses of technologies to the service of meaningful learning experiences, supported by complex convictions about pedagogy, content and technology.

1.3 Sub-question 3: PR shown in TPCK-informed design tasks

The third research sub-question (§B- Chp.1) investigated student-teachers' pedagogical reasoning when performing TPCK-informed design tasks. These were observed twice: when participants were at their first experience with this kind of task, and after they had multiple experiences (i.e. two). Data was collected through focused interviews (Cohen et al., 2007) with a semi-structured protocol (§B - Chp.3.3), each one lasting 30 to 45 minutes per participant, per session.

Once again, the reader should keep in mind interviewees participating to the first round of interviews were 18, while only 12 of them completed the second interview (see §B-Chp.3.3). This condition was beyond the control of the researcher (as the interviewees were volunteers), and could have had implications in the data collected, e.g. with a non-controlled selection of interviewees. In the attempt to preserve the richness of the first interview data (Stake, 2006), every participant was included. Moreover, non-parametric comparisons through ENA between the 12 two-time interviewees and the 6 one-time interviewees for the first round of interviews showed that the two samples were not significantly different in terms of reasoning codes. Hence, the 12 two-times interviewees can be considered eligible to provide as relevant data as the whole 18 first-round ones.

In the next paragraphs Cypriot findings will be reported for this research sub-question, considering both the first and second design cycles. First, the most and least mentioned reasoning dimensions will be introduced, using as lens the PR adapted model already described in §B-Chp.3.1

(see Picture 1.3). This, to better detect any match between the reasoning instances shown and the task procedure's possibly intended ones.

Then, it will be reported how participants would talk about the teacher and pupils' roles[37], technology's role, and any coherence or link among the different decisional turning points mentioned. To do so, the ENA software for data visualization will be used. Finally, and to further approach the core of this research, it will be inspected if and how student-teachers recognized a connection among their concerns and decisions when performing a technology-enhanced design task, and their given guidelines.

Picture 1.3 PR adapted model in design tasks.

[37] Although these could rightfully be considered instances of pedagogical beliefs (hence considered in the second sub-question), in this section only factual and situated descriptions of roles are considered, as clear intentions/decisions for action.

AT THE BEGINNING OF THE ACADEMIC JOURNEY FOR TECHNOLOGY INTEGRATION

Once completed the first design cycle, Cypriot student-teachers (N= 18) would express concerns relatable to several reasoning dimensions, although providing different explanations. Figure 1.8 shows the percentage of interviewees mentioning to have thought about issues connected to the PR dimensions.

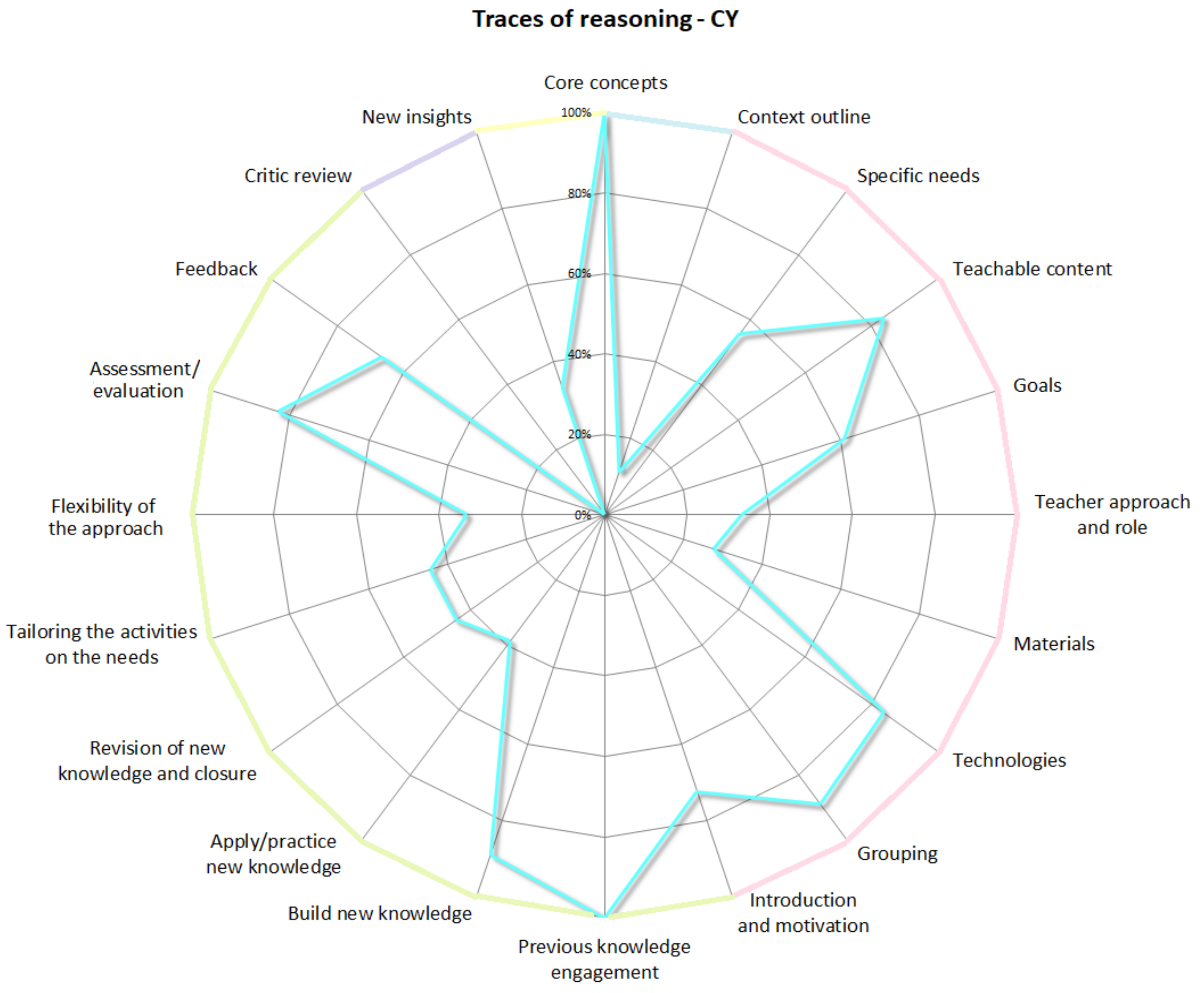

Figure 1.8 Traces of reasoning - CY first interview (frequencies).

From a first look to the figure, it seems the participants would deal mostly with the first reasoning step of *subject matter comprehension* (light blue wedge), then reflecting differently on the various steps of *enabling connections – transformation* (light red wedge) and the first and last stages of *teaching and learning* (light green wedge), with apparently low interests for *reflection* (purple wedge) and *new comprehension* (yellow wedge).

Going more into detail, every interviewee would allude to the importance of reflecting on the *topic* of the learning unit they created. In most cases, the broad discipline and/or specific content were the first information participants would disclose when talking about their design products. When asked about their deep knowledge about the chosen content, though, four (22%) would simply deflect the responsibility to the Ministry, which would provide what is important to address (e.g. "We got that [i.e. the content] from the MOEC[38]" CY12a). Others relied on the classmates' decisions, again not claiming strong responsibility to deeply understand the content at stake (e.g. "Actually it wasn't my choice, it was my friend's choice…I just lived with it" – CY9a; "my team has decided about the subject you know" – CY18a). Nevertheless, others would try to consider the syntactic and synthetic content structure, especially in relation to their possible pupils, e.g. "I didn't put a lot of information inside, just the main information not the small information that they didn't have to use or know" (CY16a); "[we were thinking about a] first class, so it was really difficult for them [i.e. the pupils] to understand anything that wasn't simple, so we had to adjust our knowledge about every [geometric] shape" (CY11a); "At first, I was searching like an adult and then I wrote [on Google] 'animals in in first grade' or something and I found some easier words, and I searched about misunderstandings misconnections" (CY7a); "I had in my mind that we have to do to do the lesson about all of this [i.e. fractions] not only about which is bigger, it was better to just do which is bigger or smaller not to incorporate too much information […] because I think you have to fragment the topic, and so you don't confuse the children eh so they can be able to learn you know step by step, not everything in once" (CY9a). Comments like these, while dealing with the core content knowledge, already include mentions of *transformation* of expert knowledge into teachable content, as if the two were not really separated for the Cypriot participants.

Moving to the *enabling connections/transformation* reasoning dimension (light red wedge), there are some interesting findings. Most participants (83%, n:15) would report dwelling upon how to make the content accessible for their pupils (*teachable content* - e.g. "we know about the bees more things that the children…and children they have no touch with bees, and we have to teach them about this theme. We have to make it more [easy for] understanding, [for children] to learn it more easy" - CY4a; "Because with the fractions you see, because it was third grade, we decided not to use the symbols, like [draws </>], we call them 'the whale'… it's very common […] and we just transform the knowledge that we have in the level of third graders otherwise they wouldn't understand" – CY12a). Some would also allude to the role of *technologies* in making this transformation possible, for example "[I chose to talk about my country Cyprus] because it's difficult to represent it in the class with traditional means and so I think it was helpful with technologies" (CY5a).

Technologies were indeed a concern for many student-teachers (83%, n: 15) when creating their design product. Perhaps due to the fact that they were required to use a specific tool (Kidspiration – see §Chp.1.1), interviewees' comments moved from its available affordances fitting

[38] See §B – Chp.4.1

the learning experience, as instances of access or visualization of the content: e.g. "We had designed in Kidspiration [some] exercises, we used the bars that are showing the quantities of fractions […] so they had the opportunity to see which is the bigger or the smaller and the students that had misconceptions they said 'wow, it's different!'[39]" (CY1a); "Kidspiration can help students to see pictures or hyperlink near to bees because no one knows what happens in the house of bees, and with an image or with a video sure will be more better" (CY2a); "[you] also can give to the children [geometrical] shapes like in schools we have [geometrical] shapes in small objects yes and the children touch it, play with it, but I think that Kidspiration it's more useful for the children" (CY13a). Interestingly, the interviewees would rarely mention the need to consider *non-technological tools'* specific characteristics (only 28%, n:5).

Finally, interviewees would allude to have dwelled on the individual/*social* learning dynamic, some attributing the final decision just to the task requirements (e.g. "the instructions asked for a team so" – CY6a), others going deeper into consideration of the implications for learning: e.g. "Because they [i.e. pupils] have different levels, I think, and one will help each other… for example some students will have seen a frog and [an]other doesn't" (CY7a), "Because it's the first time that they [i.e. pupils] come across this kind of stuff [i.e. the topic], so working with a friend or someone near them, it would be maybe more helpful because each student can learn in different ways so if they're on their own they might be more frightened […], maybe discussing with their partner will be easier for them" (CY11a); "I think I would make them work in groups because if they are will communicate with each other they will shape, share their ideas and it's more creative that way, I mean more than if I will [have them] working alone" (CY13a); "Because we had like a third class at primary school and we wanted them to have connections with other kids in order to have more ideas, more thought and knowledge…to have interaction and to build also knowledge with the other children" (CY17a).

Particularly interesting is to see how few of the interviewees would take time to think about the *contextual characteristics*, as time, location, equipment and setting for their learning unit (only 2 out of 18). Also the *teaching approach* codes did not find much ground (33%, n:6), as interviewees would mention the teacher mainly with the role of a helper during activities, e.g. "during each activity the teacher must to go to the groups of the children to see if they have any problem, if they have any questions, if they want to know something more about this particular activity" (CY17a). This should not be considered a suggestion of Cypriot student-teachers taking a marginal role in their ideal learning unit enactment, since they would be very decisive on how they would want their lessons to happen, as the reader will see shortly, but they talk about them more in terms of knowledge building by the learners than of teachers' actions.

When moving to the *teaching and learning* section (light green wedge in Figure 1.8) every participant would talk about the need to think how to engage pupils previous' knowledge and skills, already explored in the contextual analysis: e.g. "the first step [is] after I see their ideas and find out […]

[39] The reader should be reminded that these learning unit were not actually performed at school.

actually the misconceptions they have, I would start making some questions to make them think about it again and think what they said wrong or what they believed wrong and start building their new knowledge [from there]" (CY3a); "in the beginning with the diagnosis of the initial [ideas] you have to ask them questions to see what they already know" (CY10a); "from this activity we are going to take some [information on] the difficulties that the children may have and then we create, we build" (CY18a). Interestingly, though, despite this high sensitivity to the pupils' starting point in the learning experience, just a few interviewees mentioned thinking about the issue of *tailoring* activities, when in action (8 out of 18, 44% - "if I do it [i.e. the activity] with children and I see what they can do or they don't like something I would change things" – CY16a), or of being *flexible* to accommodate emerging challenges (6 out of 18, 33%, e.g. "you have to think how your kids are learning because some kids maybe want more time to think or other kids want less time" – CY4a).

Finally, a peak in frequencies of comments on *assessment* is noticeable, thought as essential part of most learning units (83%, n: 15), usually to be tightly connected to the goals, e.g. "It should [be a chain]…there is a connection between them [i.e. assessment and goals] because the objectives show you where you want to go and evaluation if you have obtained the objective, so there is a chain" (CY1a); "at the start we put some like learning objectives and here at the end of the assignment and based in this one [i.e. learning objectives] we understand if they know what we do" (CY5a). Here, the role of the teacher shows again: "I think I think you have to check through the whole [lesson] …you have to check how they answer your questions, how they work, from the beginning since the end, but the only reason for you to do that is only to help them […] because you are checking every time if what you have planned is working, if they do learn, you see each activity [is] the tools for these [objectives]" (CY9a), also in relation to the high consideration of *feedback* actions "The feedback [is] simple because the activities were simple that's why…the feedback was 'are you sure that your exercise is ok' or 'let's see other students…their work' and we help each other. I think the feedback it's better when it's not about the teacher but for…from the students" (CY18a).

When looking at *reflection* and *new comprehension* (respectively purple and yellow wedges in in Figure 1.8), low to none reported mentions were found in Cypriot student-teachers' interviews. It is to say that when it comes to *new insights* interviewees could refer to the impact of this design experience on their self-confidence in creating and implementing a technology integrated design product: as seen in §Chp.1.2, six out of eighteen (33%) would recognize an improved understanding of technological affordances and worth in education, after the first design cycle. No interviewee would express other *reflection* or *new insight* linked to the content or the pedagogical strategies embedded in their design process, but this could also be due to the fact that these design products were not actually implemented at school, thus lacking real-life feedback that could spark these two reasoning dimensions.

Cypriot student-teachers' first round interviews were mapped through the Epistemic Network Software ENA, to better visualize the focus of these conversations and the strongest connections among the issues addressed[40]. In Figure 1.9 it is possible to retrace, by the size of the dots, the high frequency of mentions of *previous knowledge engagement, build new knowledge* (3), *knowledge of subject matter*, *teachable content, technologies* and *assessment.*

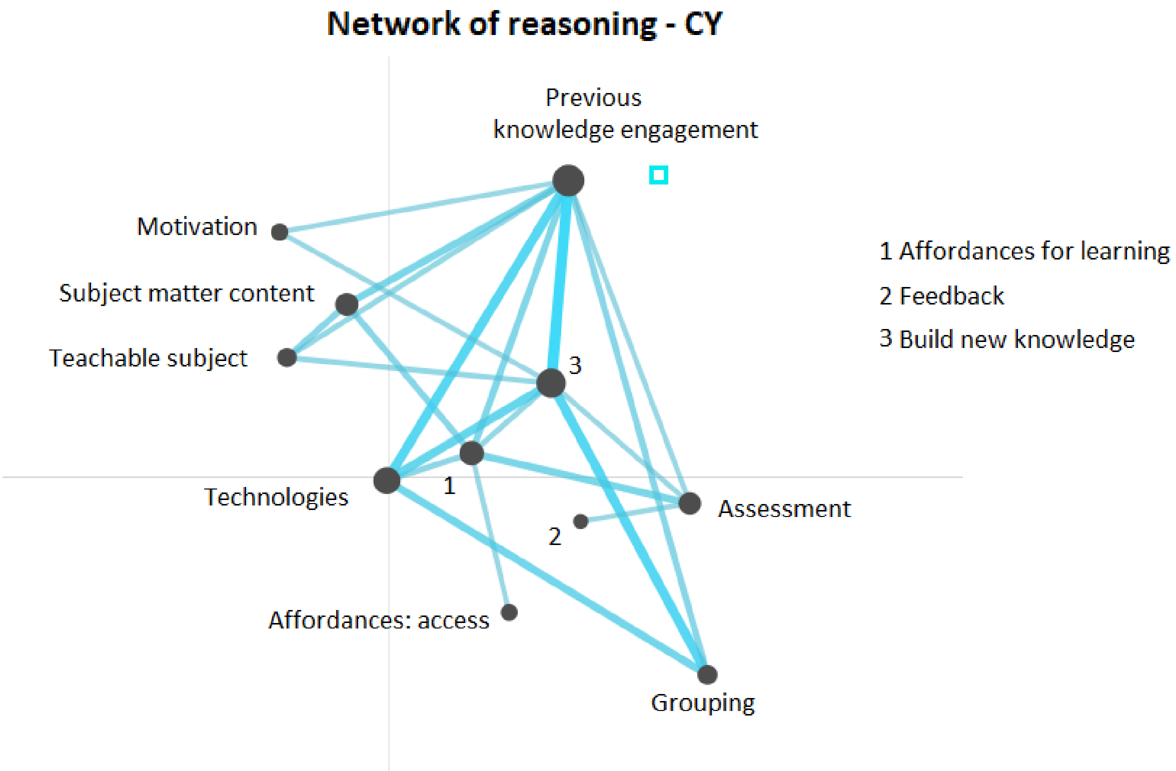

Figure 1.9 Network of reasoning - CY first interview (connections among codes).

What is most interesting in this figure is to see the lines connecting the different knots, and their distance one from the other (indicating a different role in shaping the model). First of all, the thickest line seems to connect the *engagement of pupils' previous knowledge* to *technologies*, and *building of new knowledge* (3), the latter two being strongly related to each other too. This suggests, as anticipated through the quotes above, that when interviewees talked about their decisional processes to explore and engage pupils' previous experiences (knowledge and skills), they would mostly relate that to the construction of new knowledge, also with the use of technologies. Technological *affordances for learning*[41] (1) quotes deal also with making the content accessible to

[40] For analysis and visualization purposes, ENA minimum threshold was set at 0.3, showing only the strongest connections among codes, relevant for the whole population of interviewees.
[41] This code was considered as indicator of technology impact, within the analysis of student-teachers' dispositions toward ICT integration (§Chp.1.2), it could provide interesting insights on participants' reasoning too. For this reason, when such code (and any other *affordance* one) was attributed to statements of general judgment and belief on the worth of technologies for learning, it was used within the analysis of dispositions; on the other hand, when it entailed some sort of detailed/concrete argumentation on the actual use of technologies in a learning environment, it was considered within the reasoning analysis.

the pupils (*teachable content*), and the *specific content* at stake, both implied when talking about engaging previous knowledge and building new one.

Another interesting connection links *technologies*, *previous knowledge engagement* and *build new knowledge* (3) to *grouping,* suggesting that the individual/social dimension of learning comes into the mind of student-teachers when discussing about knowledge building and technological means for it. Interestingly, though, the *grouping* quotes are very far from the knots they are connected to, indicating that their role in the discussion is more peripheral.

Finally, the centroid (little square in the picture) would suggest that the overall focus of the Cypriot participants' first round of interviews is gravitating on the side of pupils' *previous knowledge engagement*, accounting for the high sensitivity of these interviewees to their pupils' characteristics at the beginning of the planned learning experience.

Besides investigating the participants' PR characteristics, the present research was also interested in understanding the role of the given task guidelines in shaping these (as per main research question - §B-Chp.1). Considering the frequencies of the reasoning codes, Figure 1.10 displays the percentage of interviewees who would clearly connect the mentioned reasoning step to their task, in the coloured section.

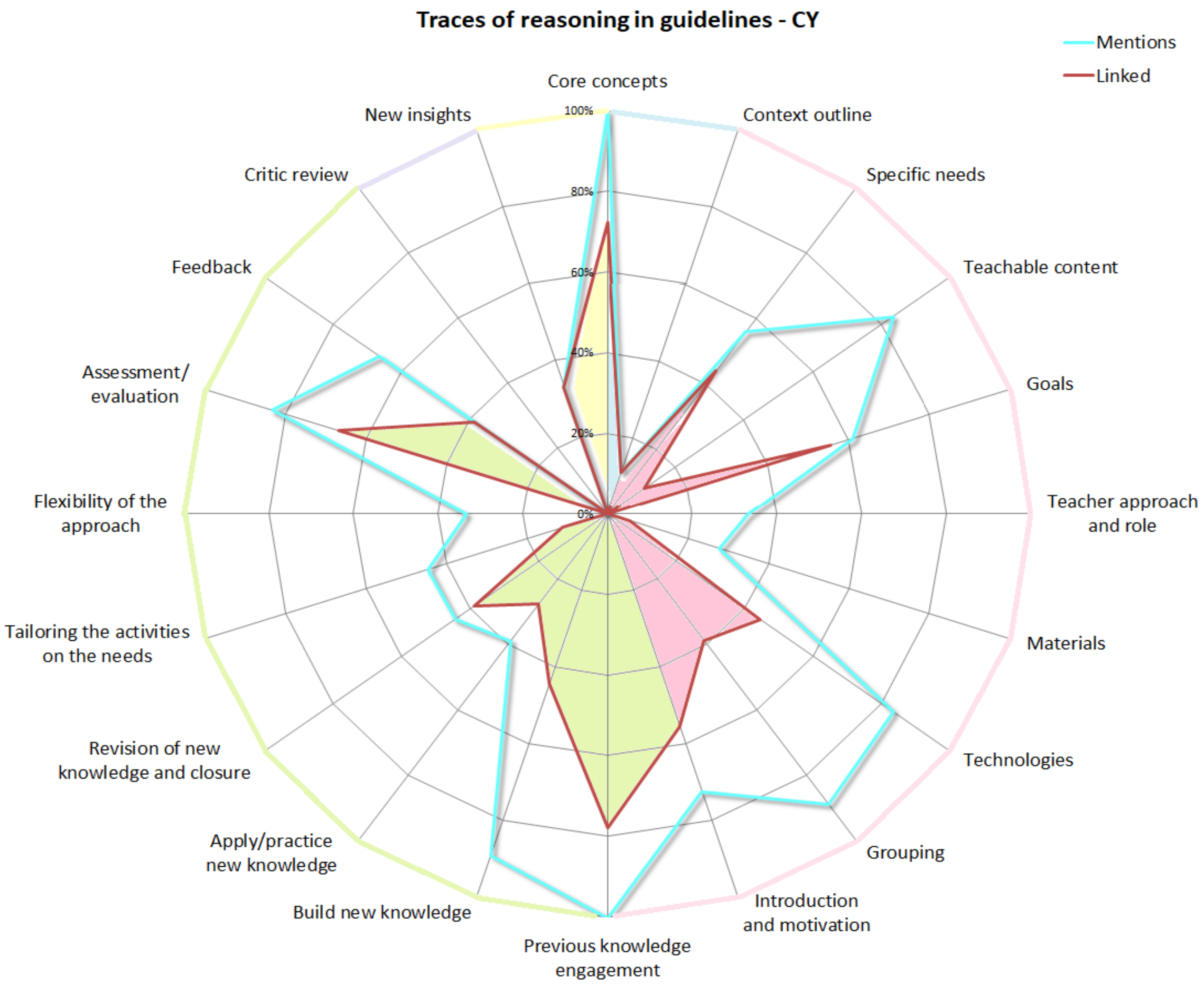

Figure 1.10 Traces of reasoning in guidelines - CY (frequencies).

It is immediately clear how the guidelines were perceived not really determinant in the decisional processes to design a technology-enhanced learning unit. Particularly wide is the gap between the instances of reasoning about *teachable content, technologies, grouping,* and *build new knowledge* and their reference to the actual task procedure. Also *tailoring* and *flexibility* quotes, not frequent to start with, find little to none recognition in the guidelines. On the other hand, reasoning dimensions that were always attributed to the guidelines were related to *new insights* (intrinsically bound to the task execution) and *context* analysis (although this was expressed just by two interviewees overall).

It is to say that Figure 1.10 considers only clear references to the task procedure, for example: "I think in this diagnosis [points at IDP 6.2], yes, I think each student must answer these questions, so you can have an idea what they know, what they don't know" (CY9a); "I think [about my content] in the first one [item], but I think in all the instructions I have to think about the topic because… except time [IDP 3] yes because I have to think about the theme to make the goals [points to IDP 5], and the activities [points at IDP 6] so…then the description [points at IDP 4] so…I think I thought a lot about the theme" (CY7a). No interviewee clearly stated that the guidelines did not ask them to think about the dimensions with the widest gaps, but they could not distinctly attribute them either, so were not considered. It is to highlight that this interview took place at the end of the first design cycle, so issues of familiarity and understanding of the guidelines could have played a role (see §Chp.1.1).

AFTER MULTIPLE ACADEMIC EXPERIENCES FOR TECHNOLOGY INTEGRATION

Completing the second design cycle, Cypriot student-teachers' PR mentions shifted on several dimensions. Figure 1.11 shows how the interviewees' reasoning quotes changed from the first to the second round of interviews. Before going down to the details of the changes, the reader should be reminded that in this second interview participants were not guided in possible reasoning or design steps, but simply asked what they thought necessary to consider or keep in mind, when preparing a learning unit.

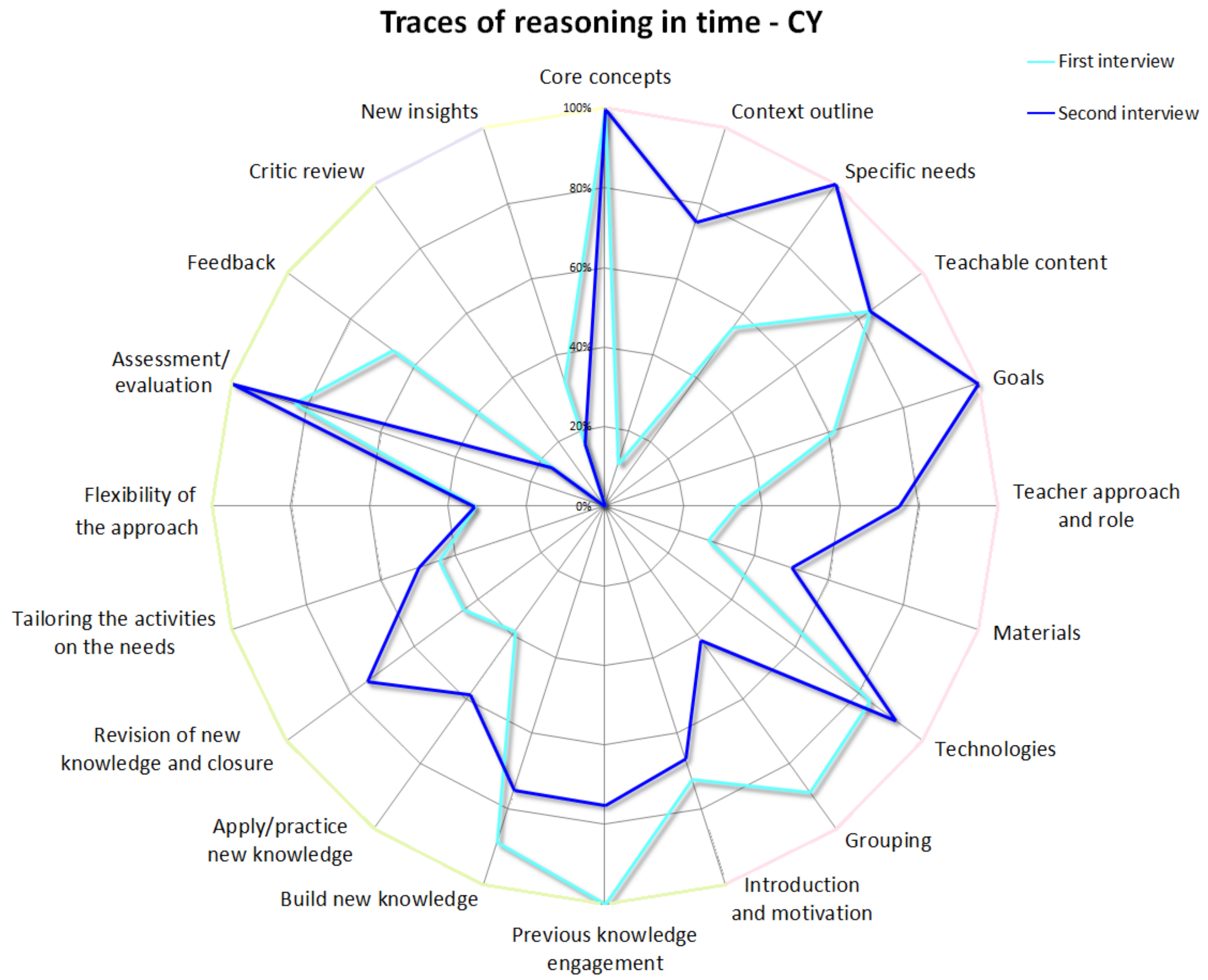

Figure 1.11 Traces of reasoning in time - CY (frequencies).

At a first glance, Figure 1.11 would suggest a wider engagement of PR dimensions, in the second design cycle. Particularly important seemed the increased mentions of *contextual analysis, specific needs, goals,* and *teacher approach,* in the overall populations.

When free to talk about what perceived essential to be addressed and reasoned through in an instructional design, regardless of their design product, the *comprehension of subject matter* still holds the absolute primate for Cypriot student teachers. Only two of the participants mentioned again a deflection of responsibility in deeply understanding the topic at stake, with similar explanations as in the previous interview (e.g. "the [national] curriculum gives you some ideas, and you have to work on these ideas and topics to help the children develop some abilities and knowledge about those topics that are in the [national] curriculum so…you may have many things in your mind, but you want to [stick to the national curriculum]" – CY8b).

In *enabling connections - transformation*, the exploration of the *context*, both in its physical setting and outline, and in the pupils' possible characteristics, seems to gain more and more importance: "how [much] time [do] I have, 40 minutes or 80 minutes? Because I have to know, I need to know how much time I have in order to see the objectives, how I will plan" (CY 1b); "[I would like to know] the age and the number of students because maybe I want them to work in pairs or in groups so I have to know also the number" (CY7b); "I would have to consider about the children in the classroom, their age and their knowledge" (CY8b); "[I would also like to know] how the students interact with the teacher and with each other, their behaviour" (CY12b). In the second round of interviews, participants seem also more concerned about the *teacher role* in the educational experience, albeit remaining projected on the learners, for example: "as a teacher I have to watch the children, how they are working, if they have any problems, if some of them didn't manage to do all the activities…of course, all the time I have to be around them and watch how they are working and if they have problems with the technology" (CY1b); "[I need to consider the pupils' interests] because I'm not going to teach something that I like and the kids don't like" (CY5b); "I will go around and I will check how they are doing, but I will not give them any answers, I will let them decide but the only thing that I will check is the way they are working, only if their work is…continuative" (CY9b); "I want to draw their attention, so I will make sure they understand what they are doing and why, and the importance of learning letters" (CY11b).

There was an ambivalent trend in quantity of quotes about *teaching and learning* related reasoning, and interesting was to hear student-teachers use the same lexis of their guidelines even if these had not been nominated at all by the researcher, e.g. "I'm going to organize the activities like the motivation, in the building new knowledge I will use Kidspiration and the diagnosis of initial conceptions and destabilization of these conceptions…in here I'm going to use Kidspiration but in all the other steps like revision and comparison of initial ideas I think I will not use eh Kidspiration because I can bring real materials to [let the pupils] see [the topic]" (CY5b).

Also interesting was to see how second-round interviewees would spend less time wondering about *grouping* and *feedback.* About the former, although fewer mentioned the need to consider it as part of their lesson plan, the interviewees who did, related clearly the issue to pedagogical and content reasons (e.g. "[I want them to work in groups] because I want to give them different types of sources so they can make their own thinking about what they eat or what they dressed like [in history]…I will give them […] primary and secondary sources, and I will give them a few different in each group…so they're going to work together as a group and find out and answer all the questions" – CY9b; "I work in a Kindergarten, it's really difficult for them to work as their own, better in pairs then in groups of 3 or 4, so if you have someone who is not very powerful as a student, you need someone to drive them, and help them explore their ideas, because group work is the first step and then you go to pair work and then you work alone, so in groups so they support each other, so I believe groups will be a very nice beginning. Obviously, because I don't know the students yet as a group I could assist them, in the beginning, through their need and diagnosis of initial conceptions, so I would try to group them as I can […], because obviously you assess them throughout the lesson so I would [create better groups at the end]" – CY10). Finally, only two interviewees mentioned the need to think about *feedback* for the pupils, while *assessment* was addressed by every participant.

About *reflection* and *new comprehension* it seems that Cypriot participants did not increase their mentioning in time, still attributing the critic analysis of their design process/product to the course professor, while fewer student-teachers than before mentioned new insights about their overall profession-to-be or its components.

When looking at Cypriot student-teachers' discourse networks from the two interview rounds through ENA, a shift appears in the focus of the conversations and in the strongest connections among the issues addressed. In Figure 1.12 it can be noticed, in the blue-dots' size, the high frequency of codes related to *goals, knowledge of subject matter* (1), *technologies* (3).

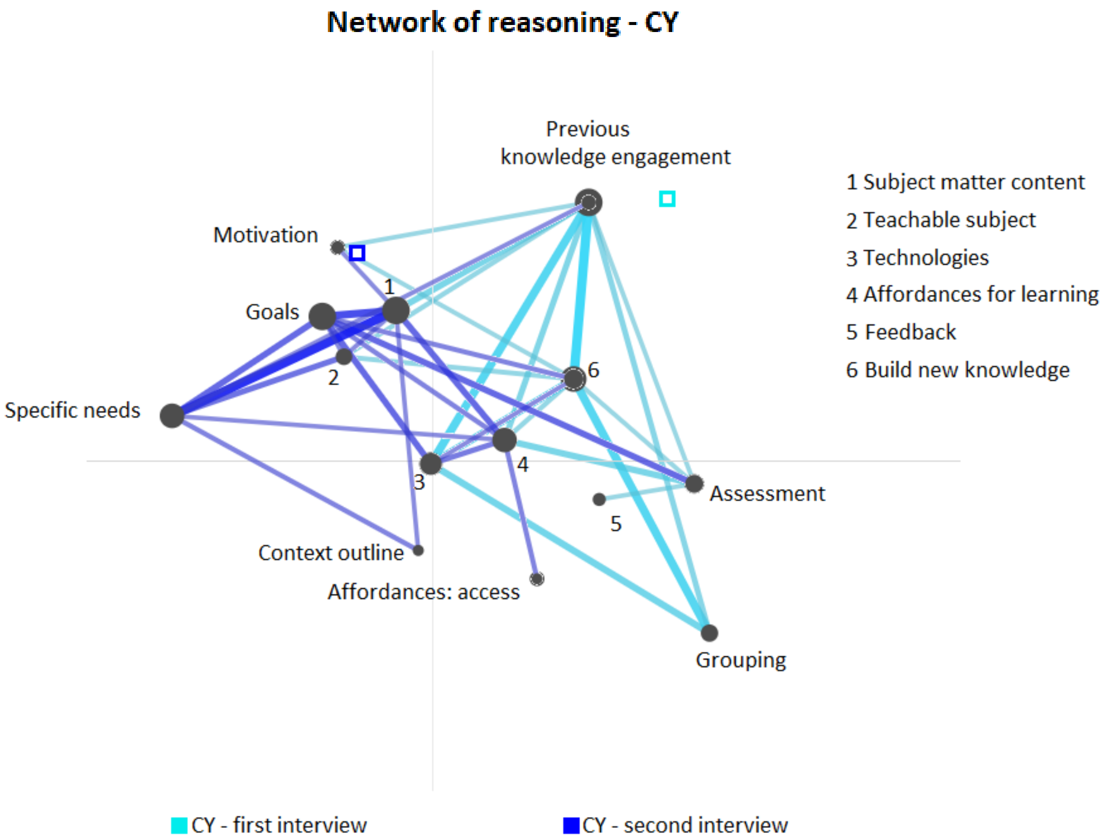

Figure 1.12 Network of reasoning - CY first and second interviews (connections among codes).

There is also a slight decrease in the frequency (hence the in the dot size) of *building new knowledge* (6) and *engagement of previous knowledge* instances. Regardless of the amount of codes, though, it appears that the thickest lines – hence connections – in the second round of interviews are among *goals, knowledge of subject matter* (1) and *specific needs* of the context. For example, "your description of the content is based on the choosing of the topic and the choosing of the topic depends on your pupils" (CY10b); "first of all [I have to know] what the students like, what they need to know, what they are interested in" (CY5b); "First the students, to know the parts that need more effort to do something, what they prefer to do in a class…and based on that do my lesson" (CY6b); "I have to know the children, what each one of my students is like, I know what they need, what they don't need, I know what it's difficult for them or easy…if I have all this in my mind I will try to find my goals for the topic" (CY12b).

Interesting are also *technologies* (3) comments, close to instances of *affordances for learning* (4) and discussed in terms of visualization of the content (e.g. "I would use Kidspiration to [make pupils] see, visualize the concepts, not only to hear them but also to see them" -CY1b; "The tools, the materials that I'm going to show them, pictures online, I don't know, maybe a documentary or I don't know what else…I have to think about the time that I'm going to need" – CY9b; "I will teach them from technology, because there are images that you can show children about the concepts" – CY12b); in relation to goals (e.g. "if I use technology it's with learning objectives" -CY2b; "[I consider technologies] where I have to do the activities because you must have in mind the [digital] story that you've done and what activities I'm going to put so the students are going to understand, and the story and the final objectives" - CY8b); or to building knowledge (e.g. "I could give them some information, they would build on the information they already know, so depending on what they already know I would build about that: if they already know what the weather is like in the seasons, it would be easier for me to destabilize their initial knowledge and build new knowledge [and] obviously I would build the new knowledge through UTellStory" (CY10b).

The discussion centroid is now gravitating on the side of the knowledge of the *content* (1) and the definition of *goals,* suggesting a new interest in Cypriot student-teachers in being prepared for the subject at stake and have clear objectives when designing a learning unit.

Once again, along with investigating the participants' PR characteristics and changes, the role of the given task procedures was investigated. Considering the frequencies of the reasoning codes, Figure 1.13 displays the percentage of interviewees who would clearly connect the mentioned reasoning step to their task, in the first (in red) and second (in green) interview rounds. Differently

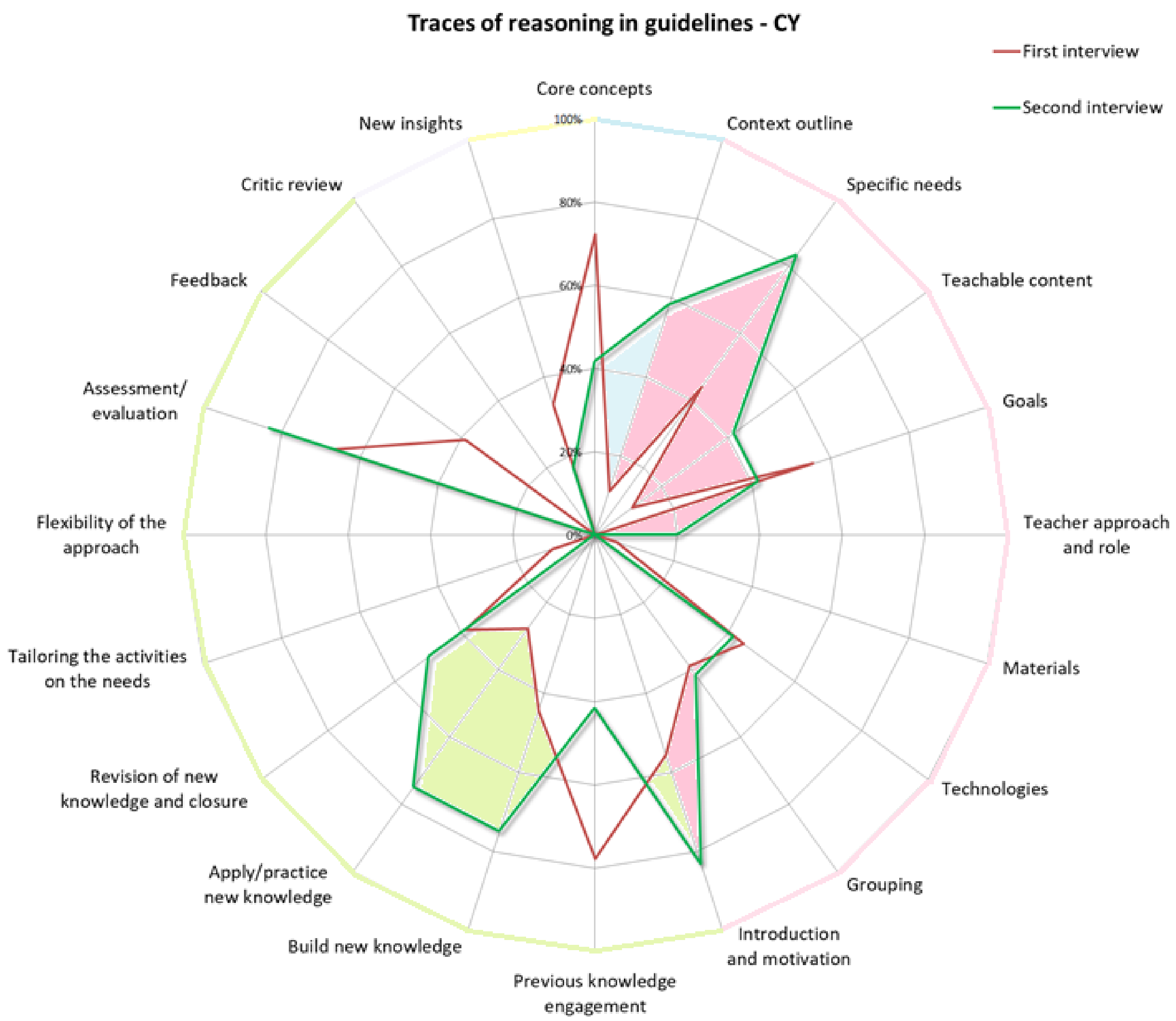

Figure 1.13 Traces of reasoning in guidelines - CY first and second interview.

from the previous interviews, the procedure-reasoning matching was not carried out through the attribution of reasoning to the guidelines, but from the participants' identification of the guidelines' parts relevant to inform the reasoning. This shift in the prompt question was made to let the participants free to state the importance of the guidelines' items in helping to create a technology-integrated learning unit.

At a first glance, it appears that the perception of guidelines' role for reasoning greatly improved in some areas (coloured in the picture), starting from *context outline,* to *specific needs*, *teachable content, introduction and motivation,* and *apply-practice new knowledge.* Interviewees would refer to the guidelines' items to explain how and why they would prepare a learning unit in a certain way, as per the quotes abovementioned, e.g. when they consistently used terms like "diagnosis" and "destabilization" when talking about the *teaching and learning* section of their lesson plan. Other examples may be: "This [circles IDP 1,2,3,4[42]] is the first thing to find, then the objectives [points at IDP 5] and now [you start with] the lesson" (CY1b); "first you have to know about the class [points at IDP 2] and the children that you have inside" (CY12b); "you need to think about learning objectives [points at IDP 5], the technology related [points at IDP 5.3] and the cognitive [points at IDP 5.1]" (CY8b); "these two [i.e. content - points at IDP 1, 4] are connected with all these [i.e. goals - points at IDP 5, 5.1-5.3], this is one group and this is another…and these [i.e. classroom-based activities - points at IDP 6, 6.1-6.6] are the steps for building new knowledge, […] because they have an order, for example you have to start with this [points at IDP 6.1] and then this [points at IDP 6.2] and then this [points at IDP 6.3] and then this [points at IDP 6.4] and then this [points at IDP 6.5] and then this [points at IDP 6.6], it's just the logical order that you follow when you decide what you're going to plan for your lesson" (CY7b). Furthermore, half of the second-round interviewees commented on how "everything is connected! It's all linked!" (CY12b), "[all the issues] are connected, one influences the other [points at all items]" (CY5b).

On the other hand, fewer interviewees than before would comment on the relevance of items to decide about *subject matter comprehension, goals,* and *engagement of previous knowledge.* Sometimes interviewees would mention the irrelevance of the issue: "description of the content [points at IDP 4] I don't think a teacher would need the description, I mean you're doing the subject you're prepared for, to teach, and if you need to know more about all the things you have to do, you write your goals…I think the description is for someone else, but if we are the ones doing it…I don't find it so useful" (CY3b); "If I would have to teach my kids in my classroom I wouldn't think about that [i.e. description of the content, IDP 4] because I would know in my mind why I did this, so I think it wouldn't be necessary to write it down and think every time about it" (CY8b); "higher level skills goals [points at IDP 5.3] are not important because they are kindergarten kids, I think it's not necessary" (CY4b). Other times, they would comment on the perception of an artificial

[42] As per §Chp.1.1, these IDP items read: 1. "Topic choice"; 2. "Class"; 3. "Timeframe"; 4. "Topic summary".

categorization provided by the guidelines, not reflecting their actual reasoning process on the matter, for example: "I haven't used these three [i.e. types of goals – points at IDP 5.1-5.3] because these are all in the objectives, the learning objectives [points at IDP 5]" (CY11b); "I think that destabilization [points at IDP 6.3] and diagnosis [points at IDP 6.2], I can do in motivation [points at IDP 6.1] […] and the revision [points at IDP 6.6] it's something….I think it's the same with evaluation [points at IDP 7] so it's not necessary" (CY2b).

Finally, several would comment on the matter of use of *technologies*, within the procedure, which as the reader might recall (see §Chp.1.1) were explicitly reported in item 5.2 *technology related goals*, although implied as tools in the whole procedure for design. Interviewees seemed to make often the association between technology use and technology-related goals (e.g. "[I don't think about technology use], except [if] I use technology so then I will use technology related objectives [points at IDP 5.2]" - CY9b). Nevertheless, it is important to remember that while 92% (n=11) of the interviewees would report some reasoning on the topic, only 42% of them would recognize any link with their task or guidelines prompts.

1.4 Cypriot case answer to the main research question

The Cypriot case study engaged 133 pre-service teachers training to become generalist teachers at (pre-) primary education level (§B-Chp.4.1.1). Within the Cypriot context, these types of teachers are required to teach any discipline at (pre-) primary schools in realization of the National Curriculum guidelines for pupils' content knowledge and positive learning attitudes development (see §B-Chp.4.1.1). Furthermore, the educational policies at national level stress greatly the importance of integrating technologies (MOEC, n.d./d), meticulously instituting infrastructure and dedicated staff to support digitally integrated teaching practices (§B-Chp.4.1.2)

Specifically, the participants to this study (aged mainly 17-22) were attending what they stated being their first academic experience for technology integration in education[43] and most of them did not have any previous teaching experience (§B-Chp.4.1.4). These student-teachers entered the observed academic course reporting wide access to digital technologies[44] and fair interest in engaging with them. Their familiarity with the use of ICT personally and for leisure (e.g. social media) was slightly above average, but they stated to be quite new to the technology use in education (§B-Chp.4.1.4). Overall, they seemed also quite appreciative of the surrounding encouragement and academic support to integrate technologies in education. This situation changed just slightly throughout the course and the two design cycles within, as they became significantly more familiar with educational technologies and their application (§Chp.1.2). These findings seem

[43] At least at university level.
[44] Almost everyone stated to own at least one device connected to internet (§B-Chp.4.1.4).

to realize the academic course's aim to foster student-teachers' technical capabilities and awareness for ICT educational uses, also through design tasks (§B-Chp.4.1.3). Furthermore, they are in line with other researches stressing the positive impact of design processes in offering "meaningful exposure to technology integration in educational contexts" (Baran & Uygun, 2016, p. 48) and enabling (future) teachers to make "informed decisions" on the matter (Conole & Willis, 2013, p. 28).

Cypriot student-teachers entered their course moderately positive about the worth of integrating technologies, compared to the emotive and practical hurdles they perceived (§Chp.1.2). Their initial self-efficacy was quite good, despite the slightly above average familiarity with technologies, and it consolidated in time. Given that the participants eventually claimed to be more familiar with the use of educational technologies and increased (just slightly) in their emotive barriers and concerns for its educational worth (§Chp.1.2), it could be inferred that an initial possibly over-estimated confidence actually grew into a more informed one. During the course and the two design cycles within, Cypriot participants maintained their cautiously open approach to technology integration in education, though significantly growing in their self-measures of capabilities to enact TPCK-informed practices (§Chp.1.2). Such conformation of beliefs, attitudes, self-efficacy and TPCK measures would suggest encouraging conditions for future successful technology integration (Abbitt, 2011; Ertmer & Ottenbreit-Leftwich, 2010), as they are widely acknowledged to be strong predictors of intention and behaviour (Banas & York, 2014; Farjon et al., 2019; Forkosh-Baruch, 2018; Scherer, Siddiq & Teo, 2015; Tondeur et al., 2017). Six participants even clearly stated that the attended course and its tasks eventually made them more open and positive to integrate ICT (§Chp.1.2). This could figure as further facilitator in future enactment of meaningful technology integration for learning, as suggested by the literature (Banas & York, 2014; Ertmer & Ottenbreit-Leftwich, 2010; Forkosh-Baruch, 2018).

While overall quite confident, participants' words associated low self-efficacy instances and feelings of avoidance and anxiety towards ICT integration, with concerns about the worth in using technologies in an inadequately equipped context and under constant pressure from the society, reminding the similar findings of a national report on Cypriot teachers (Cyprus Pedagogical Institute, n.d.; Roushias & Mardagijs, 2011). Such co-occurrence of doubtful self-efficacy and ICT avoidance seems to indicate what is known in the literature as barrier/filter effect of dispositions on behaviours (Ertmer, 2005; Ertmer & Ottenbreit-Leftwich, 2010; Kramarski & Michalski, 2015). Several studies relate self-efficacy with the willingness to choose and participate in technology-related activities (Agyei & Voogt, 2011; Kavanoz, Yuksel & Ozcan, 2015; Tondeur et al., 2017), while worries about technology use due to contextual limitations and concerns on its overall benefits for both teaching and learning, could figure as instances of resistance to change (Agyei & Voogt, 2011; Kimmons & Hall, 2016; Mathipa & Mukhari, 2014; Tondeur et al., 2012; Kim, 2016).

The open but wary participants' approach to technology integration was overall geared to possible affordances for learning and access to content. Their pedagogical beliefs were at first centred on a constructivist conception of teaching and learning, attributing high value to tailoring the learning experience for specific pupils so to make it meaningful. Interestingly, at first, instances of considerations of not accountability of the teacher shared with high technology self-efficacy mentions their role in shaping participants' dispositions. Considering the overall fairly positive initial self-efficacy, Cypriot participants at first expressed an idea of teacher vulnerable to contextual pressure and limitations, with little accountability and discretional space of action. As this was an initial finding, it could account for the conceptualization of teaching and learning experienced by student-teachers in their previous educational career and/or personal experience. This once again reminds of the results of a national report on Cypriot teachers (Cyprus Pedagogical Institute, n.d.; Roushias & Mardagijs, 2011), which expressed the need for further practical pedagogical support to integrate technologies, notwithstanding a good confidence in being personally capable to use ICT for educational purposes.

Cypriot student-teachers' dispositions for technology integration changed through time with respects to their configuration, whilst not greatly in their overall means (§Chp.1.2): by the end of the academic course, the recognized potentialities of technologies in education became associated with the perception of self-efficacy and professional expertise. As reported in the literature, teachers' understanding of how teaching/learning experiences may benefit from the use of technologies, associated with a good self-confidence in realizing such benefits, could greatly influence the intention and possible enacted behaviour to integrate (Ertmer & Ottenbreit-Leftwich, 2010; Joo, Lee & Ham, 2014; Joo et al., 2018; Kimmons & Hall, 2016; Ottenbreit-Leftwich et al., 2018; Petko, 2012). By the end of the course, participants' dispositions on theoretical and practical TPCK came closer to each other, both leaning towards affordances for the enhancement of learning. These findings are in line with other researches on the uses of design tasks to foster (student-) teachers' TPCK, as these make clear the situated interconnections among technology, content and the means to teach it (Baran & Uygun, 2016; Harris & Hofer, 2009; Koehler & Mishra, 2005b; Kramarski & Michalski, 2010; Mouza et al., 2014; Tondeur et al., 2012), while enhancing learner-centred orientation (see Chai et al., 2013). The ideal educator eventually became an empowered teacher as it figured more in control of the educational practice, although recognizing a central role of the pupils in it too (§Chp.1.2). The initial perception of teacher with limited accountability lost ground to a more empowered one, whose possible teacher-centred drift might be inhibited by the overall strong attention for a meaningful learning experience, shaped also by pupils' choices. Furthermore, the Cypriot student-teachers' dispositions after two design cycles shifted their centroid to the perception of impact of technology use on learning, once more highlighting how these tasks might have concurred in developing an open, engaged and intentional TPCK approach for learning-centred technology integration (as per Angeli & Valanides, 2009; Kim et al., 2013; Valanides & Angeli, 2008).

Said dispositions' configuration could be recognized in informing participants' reasoning, showing the great influence already known in the literature (see e.g., Farjon et al., 2019; Smart, 2016; Tondeur et al., 2016a). During their first design task, Cypriot student-teachers' reasoning was very concerned with deliberations about *subject matter comprehension*, sometimes deflecting responsibility (e.g. to the national curriculum requirements), but usually in close relation to issues of making the subject matter teachable, accessible to their pupils, even with technological means (*transformation* - §Chp.1.3). They were not too concerned with analysing the educational context or the specific needs of the pupils (with also low instances of tailoring and flexibility issues), but very keen on engaging learners' content knowledge building processes (§Chp.1.3). In their first design task, participants' words explained the teacher role and approach in ensuring the enactment of a meaningful process of knowledge building of their pupils. This changed in time, as they grew more aware of their role as teachers and discussed more in details about their approach within a more thoroughly analysed educational context. Once again it is possible to see how reasoning instances aligned with dispositional ones about first a peripheral teacher mainly focused on pupils' learning processes, and then an empowered teacher, aware of his/her role in these dynamics. Such findings seem to connect to the theoretical background of the design task implemented (i.e. *Technology Mapping,* Angeli & Valanides, 2009), meant to guide teachers' thinking when performing technology-integrated design, for a deeper understanding of their critical role in a situated and learner-centred perspective (see also Voogt et al., 2016).

Moreover, through the two design cycles, these participants became more and more attentive to the real characteristics of their pupils and the educational context (*enabling connections/ transformation*), focusing on the clear definition of context-sensitive content and goals, and their assessment (§Chp.1.3). Here it can be detected an improved awareness of the broad educational system in which these student-teachers will be called to operate, for example in relation to special need students attending mainstream education (§B-Chp.4.1.1). Technology integration maintained its importance in participants' reasoning as they became more concerned about how to use it to make the content teachable and accessible for the pupils (*enabling connections/transformation* dimension). At the end of the observed course and two design cycles within, the configuration of participants' reasoning was mostly focused on decisional steps taken outside and before entering the classroom (*comprehension, enabling connections/transformation* dimensions), accompanied by low stances of flexibility and tailoring once the lesson is in-action (*teaching and learning* dimension), and an improved attention for an empowered teaching approach. Such findings may suggest a positive growth in student-teachers' interest for carefully prepare their action but may also carry the risk of resorting to traditional/fixed routines. Nevertheless, as reported in the literature, the described findings about underpinning dispositions and emerging reasoning mentions would suggest favourable conditions for future meaningful practices of technology integration (see Forkosh-Baruch, 2018; Kim et al., 2013; Ertmer et al., 2012; Joo et al. 2018) identifiable in

> "the teachers' conscious alignment between specific learning goals for their content, (content specific) pedagogy, affordances and limitations of technology and teachers' and pupils' roles in order to produce meaningful learning outcomes and to prepare students for life in a digital world" (Smits et al., 2019, p. 93, see also Farjon et al., 2019).

Furthermore, it is to be considered that these participants did not try out their design in a real classroom, which might have ingenerated different reasoning considerations on the *teaching and learning* reasoning dimension, as well as on the *reflection* and *new comprehension* ones (e.g. Smart, 2016).

The main research question wanted to see the possible link between these reasoning processes, informed by underpinning dispositions, and the very design tasks student-teachers were required to perform. What was the role of the Cypriot design task procedures and experiences, in sparking the kind of reasoning detected?

In the participants' words was possible to recognize the academic lexis related to pupils' knowledge building processes (i.e. diagnose/destabilize previous knowledge, build/apply/revise new knowledge, see §Chp.1.1) and the pedagogical stance to use technologies (i.e., as per course's mission statement identifying technologies as a cognitive tool to the learning experience). This reflects the task's theoretical background in *ICT-TPCK* (Angeli & Valanides, 2009) and *Technology Mapping* (Angeli & Valanides, 2013), by which the teacher should move from understanding pupils' content (mis-) conceptions to successfully integrate technology as cognitive partner for learning.

Designing a technology integrated learning unit (and with the specific given guidelines) was a new experience for every interviewed student-teacher, perceived too difficult by just a very few. Almost everyone claimed to have used the mandatory guidelines in performing their design, and at first an encouraging number of them would recognize a connection between what they reasoned about, and what they were required to perform. This was promising also in consideration that, in the first design cycle, seven participants thought the task guidelines were unclear and a few of them were not satisfied with the support received in understanding them. In the second design cycle, student-teachers became more familiar with the task, although ICT integration proved still a bit tricky. As they continued to have confidence in their skills, growing awareness of educational technologies and TPCK-informed practices, the given guidelines were recognized more relevant in shaping design reasoning by the end of the second cycle (§Chp.1.3). Moreover, half of the interviewed participants reported an overall net-like reasoning process, in a more mature consideration of the intertwined and situated relationship among all the components of the reasoning process for technology-integrated design (see also Koehler, Mishra & Yahya, 2007; Smart, 2016; Starkey, 2011).

Nevertheless, rare was the perfect match between task prompts and reasoning instances, in the words of Cypriot student-teachers, with the interesting example of *grouping* occurrences: every interviewee would link it to their guidelines whereas it was not clearly mentioned in them (see §Chp.1.1). Such finding could suggest a high impact of the suggestions provided by the course professor about the completion of the task (§Chp.1.1). Overall, the design task procedure was found most significant in triggering considerations about context/pupils' specific needs exploration and social dynamics of learning (*enabling connections/transformation* reasoning dimension); and about processes to build new knowledge and link it to naïf one, along with assessing the educational action (*teaching and learning* reasoning dimension). On the other hand, while through the design cycles some reasoning dimensions increased in occurrences, their connection to the task and its guidelines remained the same or even decreased, e.g. about defining/understanding the subject matter and goals, analysing technologies' affordances (*comprehension* and *enabling connections*), deciding on tailoring and being flexible in the teaching action (*teaching and learning*). As described earlier (§Chp.1.3), these findings account for participants' perception of irrelevance or artificial categorization of the task guidelines in supporting reasoning, at a time when they were familiar with the procedure and grown in their TPCK (i.e. at the end of the academic course).

All in all, Cypriot design task and guidelines seem to have had a modest impact on student-teachers' overall dispositions, which were already positive to start with, although it made them more aware of the practical possibilities for ICT integration, and secured a wary but open and quite self-confident approach to the matter (similar results, e.g. in Tondeur et al., 2017, 2019). These findings would suggest a good underlying ground for positive attitudes and intentions to integrate (e.g. Farjon et al., 2019; Kim, 2016; Knezek & Christensen, 2016; Voogt et al., 2012). The direct relation to instances of reasoning was discretely recognized, as task guidelines gained importance in participants' words through time, so much so that ten student-teachers deemed their structure highly worthy to be used in the future profession. The observed task and procedure seem a good prompt for reasoning as far as sensitivity to context (*transformation*) and classroom-based activities' (*teaching and learning*) definition go, with an interesting outcome on the conceptualization of the role of the teacher and technologies in creating an integrated learning unit. On the other hand, it seems to have some weaknesses on sparking the understanding of the subject matter (*comprehension)* and its transformation to the benefit of the pupils, the identification of (non-) technological resources (*transformation*) and teachers' flexibility in action (*teaching and learning*).

The mandatory stance of the guidelines' use could have played a role in triggering a cognitive conflict in student-teachers, many of whom expressed their reasoning in the same conceptualization and lexis they were required to work with. Low instances on the reasoning dimensions of *reflection* and *new comprehension* (this, genuinely perceived as grounded in the task), could be influenced also by the fact that these design products were indeed not experienced with a real classroom (see Smart, 2016) and pose as an interesting focus for further research. Finally, in a condition of stated familiarity with the task and free to decide the relevance of the guidelines in shaping their reasoning (i.e. in the second interview), it is to highlight once more that the discretely recognized impact of guidelines co-occurred with a stronger teacher approach conceptualization, a growth in the perceived TPCK, and discretely positive dispositions towards ICT integration. While further research would be recommended, especially in relation to the application of these design tasks to a real classroom (e.g. during internship), these findings seem promising of future successful and "considered" technology integration (Farjon et al., 20019).

CHAPTER 2.
ITALIAN CASE STUDY

2.1 SUB-QUESTION 1: TPCK INFORMED INSTRUCTIONAL DESIGN PROCEDURE AND PR REFERENCES

The first research sub-question dealt with the TPCK-informed design procedures implemented in each case study, their bounds to ICT integration models (§A-Chp.3.1) and to PR frameworks (§A-Chp.3.2). Documentation (§B-Chp.3.1), participant observation (§B-Chp.3.2) and focused interviews (§B-Chp.3.3) were the means to collect relevant data. In the Italian case study, the documents made available to the researcher included: course organization institutional summary (see §B-Chp.4.2.3); course lessons' PowerPoint presentations and online study materials; task instructions and procedure; task evaluation rubric. All documents were available in the native language only[45] and they were the same documents shared with the students during classes. Access to the University course's platform was also granted to the researcher.

As for the participant observation, the researcher spent 5 months in the Italian context (October 2018 – February 2019), attending each lecture and workshop session of the *Methodologies, Didactics and Technologies for Teaching* course (§B-Chp.4.2.3) addressed to (pre-) primary student-teachers together, for a total of 203h on the field. During this time, the researcher assumed a non-interventionist approach, albeit physically participating to the academic events (Adler & Adler, 1994; Cohen et al., 2007). Either from a corner in the room, or wandering through students' groups, she took notes through the protocols described in Section B (§B-Chp.3.2) focusing on teaching strategies and learners' responses.

The reader should refer to Section B (§B-Chp.4.2.3) for the portrayal of the academic course, while it will be now introduced the characterization of the design task instructions and procedure implemented in the Italian case study, as emerging from documentary and observation data collected.

Finally, interviews gave some insight on how student-teachers perceived the given instructions and overall design tasks[46]. Thus, the relevant findings will be presented to give a thicker description of the design task in place in this case study (Cohen et al., 2007).

Italian student-teachers were engaged in two cycles of instructional design for a technology-enhanced learning unit. Both their tasks were carried out in groups and students were bound to work within the disciplinary area of the attended workshop (§B-Chp.4.2.3). In the first design cycle,

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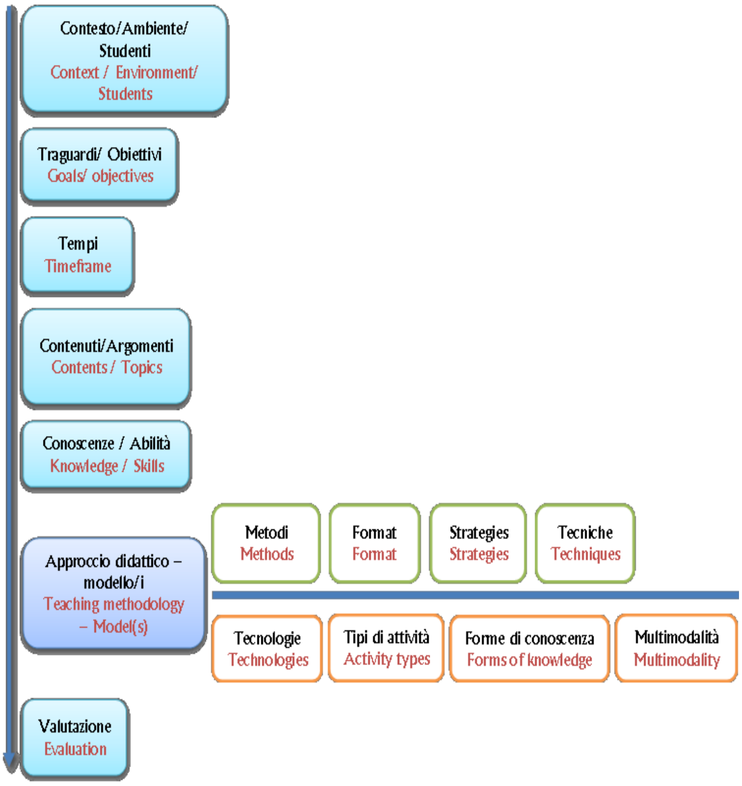
[45] As per §B-Chp.3.1, these documents were translated into English by the researcher and then approved by their author in the translation.

[46] For the specific codes and prompt questions considered, please see Section introduction and § Appendix 2.1.

students were required to focus specifically on the teaching methods and strategies, with a high PCK inclination of the design product. During this time, students were welcome (not required) to think about technological tools to be integrated in their lesson plan. During the second design cycle, technologies became the main focus and students were asked to start from their affordances to plan the lesson unit.

The design procedure they were asked to follow is represented in Picture 2.1 (in its English translation[47]). As the reader can see, there is a physical division between PCK- and TPK- based elements. Said procedure was mandatory to use and presented the following items[48]:



Picture 2.1 Italian instructional design procedure.

1. **Context/ environment/ students →** description of a class within (pre-) primary school level, according to the participant's workshop choice. This element was set by workshops' tutors and included grade, number of pupils[49], cultural background (i.e. presence of foreign learners) and school location on the national territory. It was assumed that the school would be equipped with discipline-related laboratories (e.g. art laboratory, science laboratory and so forth) and with an ICT room.

2. **Goals/objectives →** description of educational goals, formulated as European competences in their declination in the National Curriculum, according to the workshop's disciplinary outline. These too were already provided to the students by the workshops' tutors.

3. **Timeframe →** identification of duration of the learning unit. Students were also asked to specify the timeframe expected for the single activities.

4. **Contents/ topics →** brief description of concepts to be taught within the broad given discipline. They were to be specified for each planned activity within the learning unit.

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[47] English translation was provided by a native speaker (the researcher) and accepted by the course's Professor as adequate. Picture 2.1 presents the original items' order, but for the original document format please see §Appendix 1.2b.

[48] The information hereafter reported has its main documentary reference in De Rossi (2018b), in Appendix 1.2b.

[49] Pupil is referred to (pre-) primary students whom the instructional design product was addressed to.

5. **Knowledge/ skills →** brief description of the disciplinary concepts and soft skills implied in the performance of the learning unit and its activities. They were to be content-related and referring to the competences in the goals section (IDP[50]. 2), figuring as further aims for the activities.

6. **Teaching methodology and model(s) →** description of the teacher role and approach in the planned activities. Models' definition provided in the materials (De Rossi, 2018b) was "critical knowledge, based on literature, on methods' nature and possibilities, hence on their integration in teaching practice" (Messina & De Rossi, 2015, pp. 124-125). The possible choice of models laid within: process oriented, product oriented and context oriented.

   6.1. **Methods →** further specification of teaching approach, to be coherent with the previous one. Methods were deemed as "a more or less coherent subset of intentions and applications oriented to an explicit or implicit objective" (Messina & De Rossi, 2015, p. 136). The possible choice of methods laid within: affirmative, interrogative, active and permissive.

   6.2. **Format →** yet further specification of teaching approach, formats were not explicitly defined in the given material (De Rossi, 2018b), but listed in: *lectio* (frontal lesson), seminar, metacognitive intervention, workshop, and real-life experience (Messina & De Rossi, 2015, p. 139).

   6.3. **Strategies →** yet further specification of teaching approach, strategies were identified in "overall teachers' orientation in organizing learning processes" (Messina & De Rossi, 2015, p. 140). The possible choice of strategies laid between expositive and heuristic ones.

   6.4. **Techniques →** final specification of teaching approach, techniques were defined as "a more or less coherent subset of means, materials, procedures that could be self-oriented or to the service of different pedagogical methods" (Messina & De Rossi, 2015, p. 137). Several techniques to choose from were provided, e.g. brainstorming, conceptual mapping, clinic conversation, and role play.

7. **Technologies →** identification of technologies to implement in the learning unit, described in their affordances and added value for the specific activity. Students were free to choose any technology means they thought most suitable to the purpose.

8. **Activity types →** description of the activities that would take place, teacher and pupils' role in them, technological and non-technological resources used. Examples and references for this item

[50] Instructional Design Procedure, IDP acronym will be hereafter used to refer to the procedure's items.

were suggested to be found in the *Learning Activity Types* (LAT) taxonomy by Harris and Hofer (2009).

9. **Forms of knowledge** → identification of the content-based forms of knowledge implied or enabled by the learning activities. Examples and references for this item were suggested to be found in Harris and Hofer's work (2009 – e.g. *convergent/divergent knowledge expression*).

10. **Multimodality** → identification of the modalities/languages/forms of representation of the chosen content, implied/enabled by the learning activities and the technologies chosen. It was recommended to find examples and references for this item in Cope and Kalantzis' (2009) work.

11. **Evaluation** → assessment strategies carried out in different forms, even with technology. No explicit mention/requirement about feedback.

As a further note, each group of student-teachers would eventually present their technologically-integrated learning unit to the peers and the workshop tutor, for approximately 15 min. Various was the degree of active participation to these events, and of the discussion on products' quality, as these were mainly evaluation moments for the tutors.

The two design task products were evaluated as presented in Table 2.1 (also reported in its English translation[51]). Each design product added up to 15% of the final students' evaluation for this course.

Table 2.1 Design product evaluation criteria - IT.

Criterion	Indicator	Grade (max 30)
a) Completeness of parts b) Coherence among parts c) Quality of technology integration, autonomous study and research of materials d) Presentation skills	Very good (complete, consistent, in-depth analysis of teaching techniques)	28-30
	Good (complete, consistent between parts, description of teaching techniques)	24-27
	Sufficient (complete, consistent)	18-23
	Not sufficient (incomplete, inconsistent)	<18 (failed)

Detecting the theoretical foundations of the Italian design task procedure was facilitated by the multiple references in the items' very definitions and presentations during lectures/workshops. It seems that this procedure was grounded in an integrative TPACK perspective (Mishra & Koehler, 2006) where the single components would interact and eventually build up teachers' competence in using technologies to enhance the learning experiences. Evidence of that can be found in the step-by-step modality of completion of the task: starting with the clear definition of the content and its

[51] English translation was provided by a native speaker (the researcher) and accepted by the course's Professor as adequate. Table 2.1 reports the original order of the rubric's components, but for the original document please see §Appendix 1.2c.

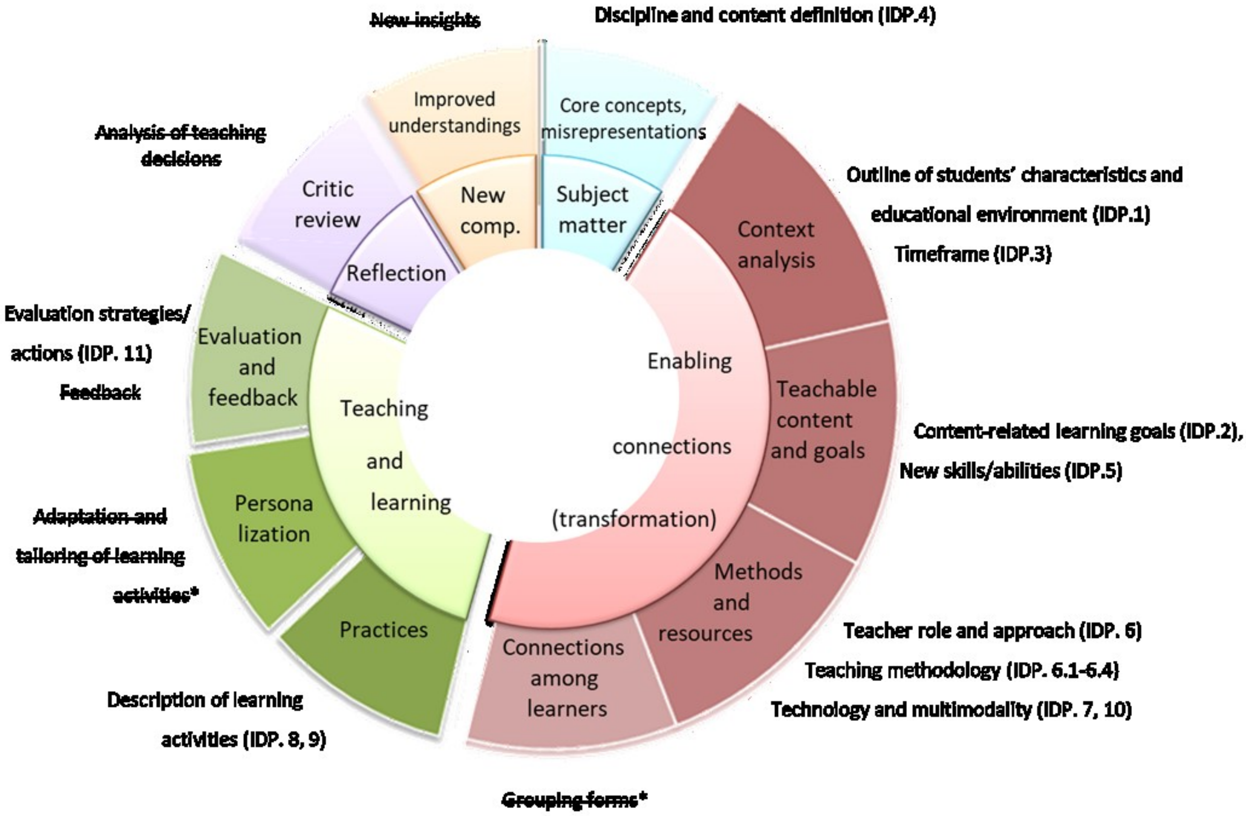
goals (CK) within a defined context, focusing mainly (if not exclusively) on teaching approaches (PK) in the first design cycle, and only then on technological affordances suitable (TK). Such an organization would align with the logic that "content drives most decisions [and] the pedagogical goals and technologies to be used follow from a choice of what to teach" (Mishra & Koehler, 2006, p. 1029) although there is a strive to enable technology to "reconstruct the dynamic equilibrium among all three elements" (p. 1030).

The almost physical separation in the two focuses of the design cycles (i.e. first on pedagogy, then on technology), visible also in the procedure's format (Picture 2.1), was referred in the words of the course professor to the work of several TPACK authors. For example, Harris and Hofer reflected on how teachers' TPACK enacted during instructional planning may be "rooted primarily in curriculum and content-related learning processes, and secondarily in savvy use of educational technologies" (Harris & Hofer, 2011, p. 211; also, Harris, Mishra & Koehler, 2009). Quite clear was also the reference to the five instructional decisions described by the two authors in 2009 (Harris & Hofer, 2009, p. 101[52]) for efficient technology-integrated design products (Messina, De Rossi, et al., 2016; Messina & Tabone, 2015), presented even in the same chronological order in the procedure.

Finally, the instructions mention concepts like *knowledge forms* and *modalities of knowledge*, referred respectively to the work of Harris and Hofer (and their LAT taxonomy – 2009, see also §A- Chp.1) and of Cope and Kalantzis (2000, 2009). In the design procedure, these were used to indicate the "multimodal representation of meaning making, which is made possible through various forms of languages" (Messina & De Rossi, 2017, p. 2), to be found in students' *mental activities*, heavily "influenced by the multimodal languages of the new technologies in which they are immersed" (Messina, De Rossi et al., 2018, p. 59). They thus figured as a further link between technological means, pupils' content understanding and teachers' pedagogical decisions.

Along with the theoretical ground for technology integration informing the tasks, any reference to reasoning models was sought, as for the research inquiry at stake. Considering the adapted PR model described in Section B (§B- Chp.3.1) as lens for data analysis, it was sought to identify any overlap with the Italian design task procedure's items (Picture 2.2).

[52] The five decisions were: (1) choosing learning goals; (2) making practical pedagogical decisions; (3) selecting and sequencing adequate activity types; (4) selecting formative and summative assessment strategies; and (5) selecting tools and resources that will benefit the learning experience (Harris & Hofer, 2009, p. 101).



Picture 2.2 PR model in design task procedure - IT.

The item's attribution to the PR dimension was made according to the former's definition within the instructions given to the student-teachers. Items 9 and 10 (namely, *forms of knowledge* and *multimodality*) were tricky to attribute. *Forms of knowledge*'s (IDP 9) contextual definition included strong bounds to the practical learning activities (*Teaching and learning* reasoning dimension) but was to be considered in a preliminary phase, when deciding about how to engage pupils (*Enabling connections* dimension). Similarly, *multimodality* (IDP 10) referred to the forms of content representation embedded in practical activities (*Teaching and learning* dimension) thanks to the choice of specific (technological) resources which would make the content more accessible (*Transformation* dimension). Eventually, *forms of knowledge* (IDP 9) was attributed to *Teaching practices* as the item was to be completed with classroom-based examples and references. On the other hand, *multimodality* seemed to remain on a more conceptual, preliminary reasoning level and was thus attributed to the *Transformation* reasoning dimension.

Some dimensions were not clearly detectable in specific items (i.e. *connection among learners* and *personalization*), but were indeed suggested by the instructors explaining how to complete the design task. In the instructions provided to the student-teachers during the workshops, it was recommended to insert in the description of classroom-based activities *grouping* forms and possible strategies for *tailoring* the teaching experience. Nevertheless, as they were not explicitly required by the procedure items or its evaluation rubric, but pertaining a more subjective interpretation of the task, caution should be used in attributing them to any reasoning dimension.

Finally, three reasoning issues were apparently neglected by the Italian design procedure: *feedback practices, reflection* and *new comprehension*. While the first one was not explicitly addressed even in other materials or course lessons (to the researcher's knowledge), the latter two were detectable in the tutors' evaluations of design products. Formative evaluation was given by the workshop tutor at the end of every group presentation, possibly triggering informal discussions among student-teachers. It is to highlight that, although the workshop was mandatory (see §B-Chp.4.1.3), and attendance was quite high in every session, student-teachers were differently engaged in the presentations. While the group being evaluated was standing in front of the class, nervously waiting for their grade, the audience was usually either preparing for their own presentation or relaxing afterwards. It is to say that, in some cases, the tutor could spark constructive discussions with the audience, but this was not generalizable to every student-teacher's workshop experience. Given these blurry conditions, it was not possible to set a clear and solid intended connection between the design task and the *reflection* and *new comprehension* reasoning dimensions on the student-teachers' side.

To better answer the research question on the task procedures' link to pedagogical reasoning for technology integration, how such tasks and procedures were understood by student-teachers was also investigated. During focused interviews (N. 31[53] – see §B- Chp.3.4), participants mentioned instances about:

- *Familiarity of the procedure*, useful to investigate possible previous experiences with a technology-enhanced design that might influence this task's performance. Whereas none of the interviewees said that the given procedure was similar to any other previously used at university (or elsewhere), just two student-teachers expressed high difficulties in performing the task due to its novelty, albeit even after the second design cycle, e.g.: "it's the first time we really do something [like this, where] we simulate the work of a teacher, because even in the previous workshops [i.e. in other courses] we did something but not this complete, so […] we didn't really see the bigger picture" (IT1a[54]); "all different courses [give different instructions], it depends on the tutor […] for example in this [course] they are the same [for everyone], but for example in maths we have different ones" (IT10a).

- *Relevance of the procedure*, analysed to understand if the student-teacher actually used the given guidelines in performing the task or relied on other resources (e.g. pre-made materials, past

[53] As the reader might recall (§B-Chp.3.3, B-Chp.4), interviewees were 16 after the first design cycle and 15 after the second.

[54] Due to privacy reasons, participants' names will be masked at all times. They will be referred through the belonging case's acronym (CY, IT, NL), a number, and the letter "a" if it was the first interview (after the first design cycle) or "b" if it was the second interview (after the second design cycle).

experiences and so forth). Every student-teacher asserted they used the provided procedure as guideline in performing the design task, and just a very few of them expressed *performance orientation*, for example: "probably if in the paper that teacher gave to us, [if] in the context was written 'there is a technological room' we'd probably say 'ok probably we have to use it' so obviously I think that our activities could [have been] very different, but it's not written so we don't think about it" (IT 15a); or "in the second [cycle] the thing I was quite afraid of was I couldn't integrate the technology so much because if I would do that I should reorganize the whole work from the start and so this could [have been] so much work" (IT2b).

- *Understanding of guidelines*, considered to identify the main perceived difficulties in comprehending and performing the design task. Guidelines were perceived as unclear by nine student-teachers during the first design cycle, but as familiarization increased these difficulties diminished so that just three mentioned them in the second interview. Instances reported, for example: "I mean instructions were easy enough to be filled but honest to say they still have lots of doubts, lot of things I still have to fix in my mind" (IT11a); "it's difficult understand technique because during the lessons the teacher didn't explain, she didn't give example and so we only copied what we read on the book without understand what they are" (IT 12a). Some would also express doubts as to the different focuses of the two design cycles: "I have thought about it, and I asked myself why we have done this work without technology first, and after with technology. And honestly, I haven't understood why there is the separation between the first and the second, because the teacher [tells] us that we have to start with the idea of technology, instead we have an idea without technology and I don't know, [I find] that is incoherent" (IT4a). When facing difficulties, interviewees reported having asked for support (4 in each design cycle), for example: "the tutor said us what is about so we analysed all the parts […] and finally we made our assignment, I appreciate that sometimes they gave us some advice so we can work better" (IT13a); "the tutor help us, she explained us what the meaning of these words [is], so now it's clear" (IT13b). Some interviewees (six after the first cycle, three after the second) would have appreciated still further support: "today there are other groups [presenting their work], they tell a lot of [teaching] strategies that I don't know, so I don't know if they're correct of not, because the tutor didn't tell if it was correct or not" (IT10a); "I asked two other people who attended the lesson and they had the same doubts" (IT11a); or "we have to improve the evaluation part and to explain better the knowledge and the skills [implied], because we weren't [taught] that so we have to improvise sometimes" (IT1a).

  Evaluation was a tricky part for many student-teachers, along with *teaching approach* (IDP.6) and sub-components, in relation to items' implications. Seven interviewees found it very difficult to think about assessment, albeit just in the first design cycle: "it was very difficult to understand the evaluation because we didn't do it at class" (IT16a); "we had some problems about the evaluation because we don't know the techniques and we don't know any chart or criteria and it's difficult without [an] explanation before by a university professor of what the different types are" (IT14a); "we don't know how to do it because we do it in 4th year so it's a bit difficult because we don't know how, but it was requested so [we tried]" (IT10a); "we don't know how to evaluate what students learn" (IT7a).

Overall *teaching approach* was difficult for nine interviewees, in their first attempt to design: "[it was difficult to] understand the type of teaching approach because I think we never think about it when we were students and now it's a little bit difficult understand the process oriented the product oriented [models]" (IT5a); "I think the techniques was the most difficult part because I had a kindergarten school [context, and] during the lessons they gave us some techniques [examples] that maybe we can apply more to the primary schools, so putting them in the kindergarten context was […] more difficult" (IT1a); "[we had some] problems especially with the strategies and techniques because in the book the teacher gave us, they were not really precise…sometimes they talk about strategies when they talk about techniques, and when they talk about techniques they talk about strategies, so…it could be a bit of trouble with these two points" (IT5a).

It is to say that assessment and teaching approach were the main focus of the first design cycle, and while a greater familiarity and possibly understanding might have occurred in the second design cycle, the absence of instances of difficulties related to these parts in the second interviews cannot be assumed as proof of ease in completing them, as: "some parts of the unit we just made the same [as the first time] so we didn't think about them" (IT1b).

- *Technology integration requirements*, investigated to see how this issue was perceived by the student-teachers in relation to the procedure's conditions. As just mentioned, ICT integration was a focus only in the second design cycle, so comments on its ease or difficulty mostly belong to the second interview round. This very structure was perceived alternatively helpful or tricky by the participants, for example: "I had a lot of ideas about technology but in the first part I can't use it so… but in this part I can do what I want to do from the beginning" (IT13b); "[I liked doing] first the method and then the use of technologies because if I use technology from the start I don't know why I project an activity" (IT9b); and "if we started from zero it would have been different because we would have begun to think with technologies already in our mind, while starting from something we already did, on the one hand it simplified our work because we didn't have to think all over again what to do and everything, but it was difficult to integrate technologies because we already thought activities in another way" (IT6b).

  When referring explicitly to the process of technology integration, seven student-teachers mentioned difficulties related to the novelty of the task ("it was the first time we had to deal with technologies like in this context and so it was really hard for us" - IT3b); to guidelines understanding ("the difficult part was [to] know the definition of activity types and forms of knowledge, their definition and application to our technology" – IT14b); to the access to technologies ("the technologies we think to introduce in our [assignment] weren't available [for free] so the tutor vetoed them because we couldn't demonstrate" - IT6b); or to more pedagogical considerations ("difficult is how we can introduce them in our work and if it is useful or not, necessary or not" - IT10b; "we wanted that part [i.e. activity] to be practical so that the kids have to learn how to use the scissors and the glue […] and we thought that with technology they would miss out some practical part and so we really struggled in that because we were really not sure how to transform that part [i.e. activity]" - IT3b").

- *Overall worth of the given procedure* as effective guidelines for designing a technology-integrated learning unit. Just three interviewees, and only at the end of the first design cycle, mentioned they would not consider these instructions valid reporting, for example "I think that maybe it's too specific […] because if we do this every time that we have to do something with children […] maybe it's too much [work]" (IT1a); or "I don't think [I would use guidelines like these] that much because in my work it's not that necessary" (IT7a).

  Others would find some worth in using the given structure only under specific circumstances, for example "maybe the first three years yes and then maybe I will start not to think every time about the techniques and ah every single minute what to do with my class […] it will be automatic" (IT8a); "if you use it all [the] time it's a very long process and the tutor in fact [said] 'no only sometimes for the big UDA [i.e. learning units] but not always' because it's very long and difficult" (IT15a).

  Finally, almost half of the student-teachers (six and five respectively after the first and second design cycle) would use these guidelines again, attributing them high worth either for design in general or for technology-integrated ones: : "I think I would use it because I think it's well done […], it makes order in my mind" (IT2a); "I think it's professional, and give the teacher more quality, and I like it" (IT14a); "I just started thinking [how to plan a learning unit] so it's very important, useful and efficient for [pupils' content-related] knowledge and not only knowledge, for the growth of the kids with these technologies" (IT11b).

These findings are relevant to the first research sub-question (§B- Chp.1) as they help understanding intended and perceived connections between the implemented design procedure and the pedagogical reasoning for technology integration theoretical models. Moreover, this information helps in answering the main research question because it sets a situated background of references to interpret data on reasoning manifestations (§Chp.2.3). From the findings reported here, the given design procedure seems to have a wide spectrum of theoretical references for technology integration, not always clearly understood by the student-teachers, who would use tentatively the theoretically-based lexis to refer to the design parts (e.g. doubts related to strategies and techniques). While the procedure was indeed new to the participants, posing some issues in understanding the specific parts and complying to the technology integration requirement, every student-teacher used it to perform the task and several recognized in the procedure valid guidelines for TPCK-informed design practices. These premises, and the overlap found between the procedure's items and most of the PR model dimensions, will pose as a ground of interpretation for actual participants' reasoning manifestations and their relation to the used procedure (§Chp.2.3).

2.2 Sub-question 2: Student teachers' dispositions toward ICT integration

The second sub-question leading this research is related to student-teachers' dispositions towards technology integration (§B- Chp.1). These were observed both when participants were just starting to deal with the issue (i.e. at the beginning of their university course and at their first concrete attempt to design with technologies) and when they had multiple experiences on it (i.e. at the end of their course and after yet another technology-integrated design cycle). In this embedded mixed method section of the research (Creswell, 2013) the implemented instruments for data collection were a pre-/post- questionnaire (§B- Chp.3.4) and focused interviews (§B- Chp.3.3). Data were collected independently in the 5 month time span the researcher spent in the Italian context, then merged when interpreting the results (parallel convergent mixed method – Creswell, 2013).

In the next paragraphs the Italian findings will be reported as emerging from the quantitative and qualitative instruments according to the specific research question. Participants' dispositions towards ICT integration will be portrayed first how they appeared at the beginning of their academic journey on this issue, considering the overall population and a typical student-teacher. Then, it will be inspected how these dispositions changed after multiple experiences with TPCK-informed design tasks, for the Italian student-teachers.

At the beginning of the academic journey for technology integration

Considering the pre-questionnaire data (N= 164), at the beginning of their university course Italian student-teachers appeared overall fairly open to the possibility of integrating ICTs in educational practices, albeit with some reticence. As per Figure 2.1, participants expressed somewhat average measures of comfort and ease in using technologies (*enablers*[55]*:* $\bar{x}$= 3.4, σ= .69), accompanied by measures of stress and avoidance on the lower end of the scale (*barriers:* $\bar{x}$= 2.1, σ= .75).

[55] As per §B- Chp.3.4, questionnaire's factors *enablers* and *barriers* included respectively indicators of comfort, ease and likelihood to use technologies in everyday practice, or to the contrary stress, frustration and difficulties in doing so.

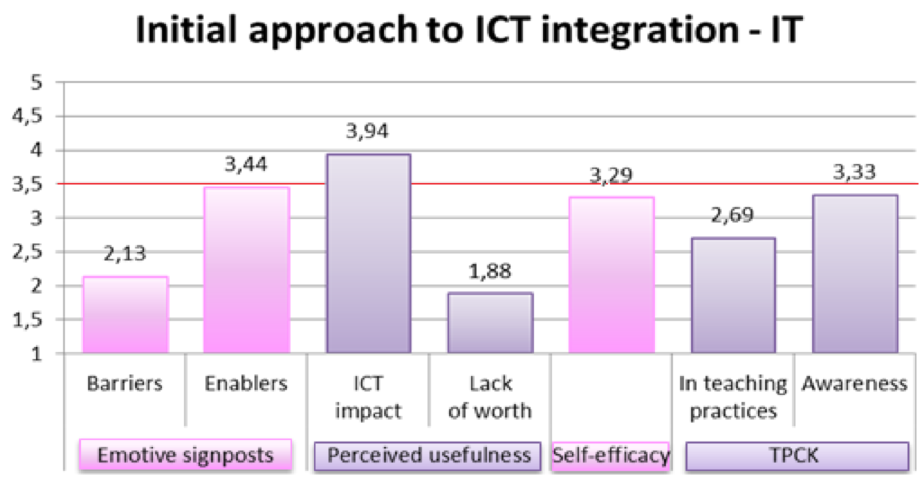


Figure 2.1 Pre-questionnaire measures for dispositions towards ICT integration - IT.

Briefly anticipating the qualitative findings, a couple of interviewees' quotes on this point: "as a person I use a lot of technologies, I like it" (IT12a); "well I use computer every day and I like also gaming" (IT4a). On the other hand, some of the less positive would say things like "I'm not really a technology person" (IT1a); "I'm not really able to use technology, I have a phone, I have a computer but if there is a problem I am not able to see a solution, I always go to ask my father or my brother to help" (IT5a); "I don't use technology, like I don't use email, I don't have Facebook, Instagram, Twitter… it stresses me" (IT12a).

Italian student-teachers would also well perceive the potentialities in ICT use for teaching and learning, as in the high score reported on the *impact* ($\bar{x}$= 3.9, σ= 0.55) and the quite low one on its ideal opposite: *lack of worth* ($\bar{x}$= 1.9, σ= 0.55). Again, just some example from the interviewees' words: "if you give the program to [the pupils] to work at home with their parents, they could improve their knowledge" (IT1a); "the younger they [i.e. the pupils] are I think the more helpful technologies can be: when a kid doesn't know how to read it's really useful to have a picture that says the same thing but in a different way" (IT3a); "with proper time and technologies of course we could help each kid, each person to have their own and best way of learning" (IT11a); or to the contrary "I don't know what I could do with technology in [my] lessons, I think that it could be like two parts: the use of technology and the rest of the lesson, I don't see a connection between the two" (IT5a); "I don't know, I think it's the same [to use and not use technology]" (IT10a); "kids must be free, they don't have to use technologies to learn" (IT12a).

The *self-assessed capability* in selecting, integrating and assessing the use of ICT in education scored just on the middle of the scale ($\bar{x}$= 3.3, σ= 0.85), suggesting an average level of confidence in student-teachers at the beginning of the university course. Its roots and details may vary, though, as detectable by the interviewees' mentions: "I knew something about it [i.e. technology use] because I did something about it in high school so it was easy"(IT4a); "I feel like I'm not very good at it [i.e.

integrating technologies] because I think you need a lot of practice" (IT3a); or on the other end of the spectrum "I know how to teach [with technologies]. I know what I studied, I know how to applicate it, [I know] how to prove it" (IT2a).

Finally, Italian student-teachers' perception of their own TPCK at the beginning of the course scored just about the average in relation to the *awareness* of possible content-pedagogical technologies ($\overline{x}$= 3.3, σ= 078), decreasing slightly though when considering their actual *practical integration* ($\overline{x}$= 2.7, σ= 0.78). As the interviewees would say: "[you can use technology] first of all for interaction, and as a chance to enjoy more the contents [...] I think technologies is a good way to make some boring lesson maybe funny, but not only funny you know, everything that can help the learning of your content" (IT11a); "I think [technology] could be very useful because it's something the kids use every day so if you want to make a topic next to them, near like to their lives, you have to use stuff that they use every day. Maybe they don't really read books everyday, but they use computers, smartphones all the time" (IT16a).

Going a little deeper with the quantitative analysis, some patterns could be identified in student-teachers' answers to the pre-questionnaire and thus were able to detect several profiles (§D-Chp.2). In the next paragraph Beatrice[56] will be introduced as the profile who gathered the most respondents among Italian participants (see Table 2.2 and Figure 2.2).

Beatrice is likely a 17-22 years old student-teacher, with an average appreciation of *university equipment* and *encouraging actions* (mean scores on these areas[57] were 2.7-3.3 out of 5 in the Likert scale). She is somehow familiar with *lower order digital applications and software* ($\overline{x}$ =2.9), but not so much with the *higher order* ones more specialized for the educational context ($\overline{x}$= 1.5). She is also keen on *surfing the internet* to explore web-based technologies ($\overline{x}$= 4.4). Although her dispositions towards ICT integration are distinctive in relation to other types of student-teachers found (see Table 2.2), they are not drastically different from the Italian means' on the issue (see Figure 2.2) and to no surprise: Beatrice ideally represents the 38% of the Italian student-teachers responding to the pre-questionnaire.

Table 2.2 Beatrice's profile in relation to the other student-teachers' profiles - IT.

Factor	Mean	Sig.*	Cohen's *d**
Emotive barriers (stress and avoidance)	1.83	≤.007	≥.65
Emotive enablers (comfort and openness to use)	3.70	.000	≥.65
Impact of ICTs on teaching and learning	4.07	.000	≥.1.21
Lack of worth of ICTs in education	1.61	.000	≥1.23
Self-efficacy	2.99	.000	≥1.45
TPCK in teaching practices	2.61	.000	≥.80
TPCK awareness	3.49	.000	≥.91
* These measures refer to the statistical significance and size effect of this profile's distance from others. As there were overall four different profiles, if manifold, the bigger (for significance) and smaller (for Cohen's d) values are displayed.			

[56] This is a fictional name and any resemblance to real events and/or real persons is purely coincidental.

[57] As the reader might recall from §B- Chp.3.4, the questionnaire's factors related to this topic are: *Surrounding encouragement* (α = .79), *University equipment* (α = .83), and *University's active role* (α = .92).

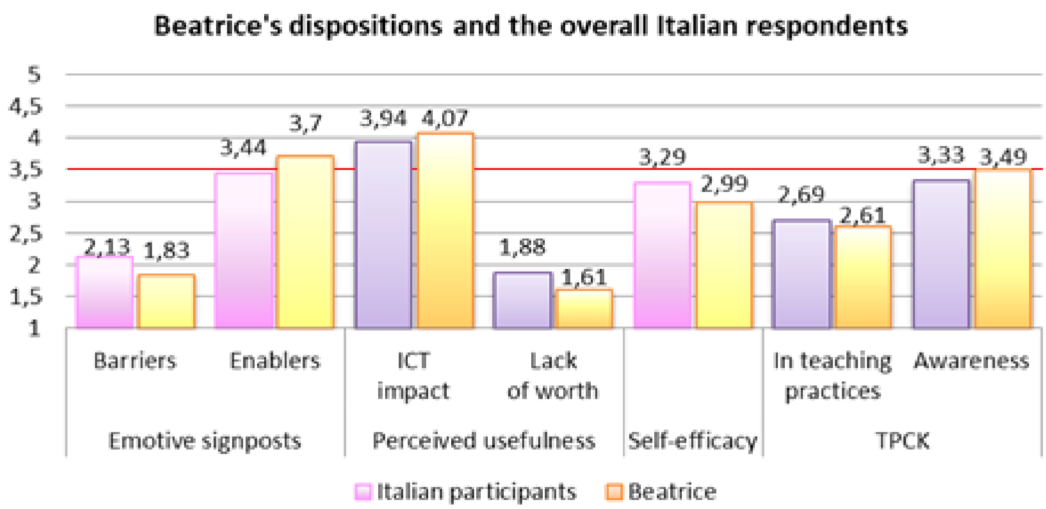


Figure 2.2 Beatrice and Italian respondents' scores for dispositions towards ICT integration

Beatrice's characteristics, so close to the overall Italian participants' and yet not exclusive to this case study, will be further analysed in §D – Chp.2 within the cross-case perspective.

Finally, to take the maximum advantage from the mixed method approach to this matter of inquiry, a multidimensional scaling was carried out on the pre-questionnaire data (Figure 2.3), while first-round interviews' (N=16) codes were mapped through the Epistemic Network Analysis software (ENA –Figure 2.4). They will now be observed together, focusing on clusters of items and codes, as in both analyses distance indicated difference in the items/codes' roles in shaping the answer/discussion.

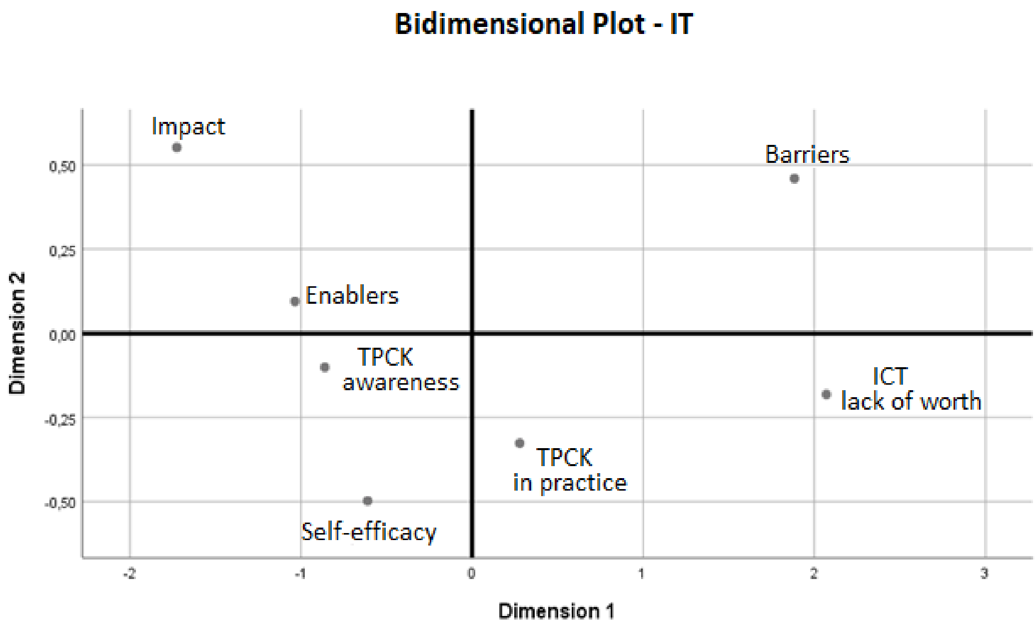


Figure 2.3 Italian pre-questionnaire respondents' dispositions (multidimensional scaling, N=164).

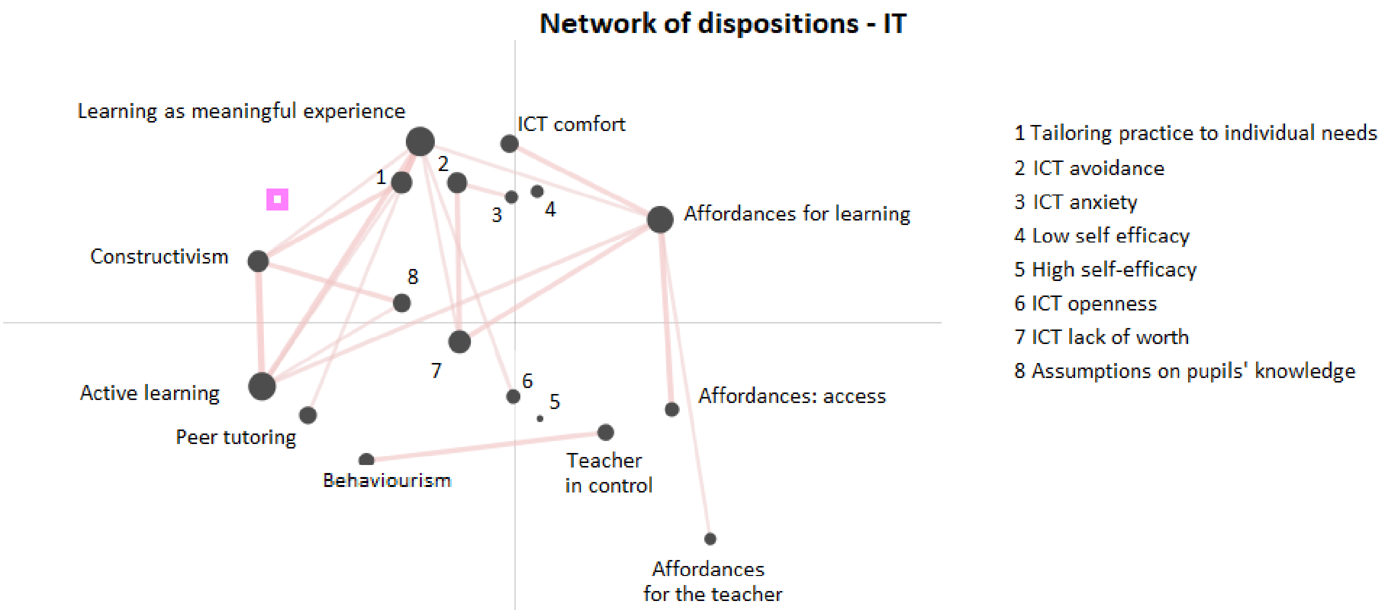


Figure 2.4 Network of dispositions - IT first interviews (connections among codes, N= 16).

In Figure 2.3 *emotive barriers* and the perception of *lack of worth* of technologies in education stand on a very different ground from *emotive enablers, self-efficacy* and the perception of *impact of technologies* in the learning experience, although clusters are quite loose. The same overall dichotomy can be traced in Figure 2.4, where *ICT avoidance* (2) and *anxiety* (3) are close together, connected uniquely[58] to *ICT lack of worth* (7). On the other hand, *ICT openness* (6 – as *enabler* indicator) connects with the perception of *learning as a meaningful experience.*

Moreover, in Figure 2.3 *self-efficacy* figures close to measures of *TPCK awareness,* suggesting a possible correlation between the two in the minds of the respondents. In Figure 2.4 instances of *low self-efficacy* (4) are close to the negative approach to ICT in education: *ICT avoidance* (2) and *ICT anxiety* (3). It is also close to *ICT comfort* suggesting that a low self-efficacy might have similar role as perception of comfort, in shaping the participants' discourse. On the other hand, comments of *high self-efficacy* (5) are far from this area, closer to *ICT openness* (6) instances, although the codes are not connected.

Interestingly, in the multimodal scaling figure *TPCK in practice* figures in the same quadrant as *ICT lack of worth*, albeit in a one-dimensional plot Dimension 2 would result prevalent. The possible connection suggested, though, can be traced in Figure 2.4 in the (long distance) connection between *affordances for learning*[59] and *ICT lack of worth* (7). While *affordances for*

[58] It is to highlight that for analysis and visualization purposes, ENA minimum threshold was set at 0.3, showing only the strongest connections among codes, relevant for the whole population of interviewees.

[59] This code accounts for all the instances related to technological affordances to: *engage* pupils in the learning experience (appealing to their previous knowledge/experience); *scaffold* and/or *improve comprehension* of the topic;

learning was considered indicator of *impact* of technologies in education, its instances for the Italian participants reflected also considerations about content-pedagogical practices, e.g.: "I don't think [I would use technologies] because for me it depends on the way you teach, the material to me is not so important" (IT10a); "we can talk to each other via Skype, via WhatsApp, but it's not the same, so the kids should still work in a traditional way in order to build all the knowledge" (IT11a); "I think technology is not for [any] normal lesson but I think for DSA [i.e. special needs students] or children that have the need" (IT13a).

Other interesting links among codes see comments of *affordances for learning* strongly related to the ones for content *access* and *comfort,* and more lightly to the creation of *meaningful learning experiences* in consideration of the benefits for the teacher (*affordances for the teacher*[60]). Examples of this may be: "Technology is part of this big work [...] I want to know the potential of technology for the learn" (IT9a); "it could be something, an instrument to teach better and to let the students learn better and have awareness of the world" (IT4a); "when I will prepare my lessons I can use computers but also programs and software, technologies which can help me make it faster" (IT16a); "technology help the teacher to understand [the subject matter] and [the pupils] understand what the teacher wants to communicate" (IT14a).

Furthermore, the connection from *constructivism* to *active learning* and the idea of *learning as a meaningful experience,* perceived close to the value attributed to *tailoring practice to individual needs* (1). Examples of this part of the network would be: "maybe my goal [as a teacher] could be improve all the skills of the students and make them rethink about the things they achieved" (IT2a); "I think if they work together and they have like a lot of time that they spend together working, building like a knowledge and help them know each other" (IT3a); "I think that the teacher should like prepare, be prepared to change and make new kind of explanations for everyone if they need a different one" (IT16a).

Interesting is also the emerging of an idea of *teacher in control* of the overall educational experience, with unique connection to a pedagogical horizon related to *behaviourism*[61], to be found in instances like: "I think that when the teacher…after saying [to] the children what is 'left' and what is 'right', she start saying [to] the children 'I put this object here, where is it? Is it on the table, is it under the table?' and the

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provide a *meaningful learning* experience (i.e. tailored to pupils' interests and needs, in a long term perspective to improve critical thinking, learning autonomies and responsibility); enable *active learning* and/or *cooperative learning;* and to address/*compensate* specific needs of the students. As perceivable, all these instances share a focus on the concrete uses of technologies within the learning process.

[60] This code accounts for all the instances related to technological affordances to: make the lesson planning easier on the teacher (in terms of time saving, materials' organization etc.); create a repository (as documentation useful for future lesson plans); manage pupils' behaviour and discipline (using technologies as punishment/reward for specific behaviours); realize drill and practice activities or assessment.

[61] This code was attributed whenever the interviewee would report on teaching methodologies/approaches or learning features typical of the behaviourism learning theory (see §A – 3.1.3 - e.g. the teacher possesses all the knowledge to transmit to the students; learners thought as blank slates - no need to check for previous knowledge; teacher relies only on him/herself, not on external tools like ICT; teacher knows best; teacher controls everything; stimuli-response-reward dynamics; self-evident performance assessment; programmed instruction; drill-and-practice interactions; classroom management tools to record, reward and share on students' behaviour). It could also imply an idea of education as mere training to the labour force world.

children have to give me the answer" (IT5a); "it's easier to control groups than single [pupils]" (IT12a); "teachers sometimes have some little problems and meanwhile children are free of doing anything they want and they get distracted during the activity and you can't manage them anymore" (IT14a). Despite this drift toward a traditional ideal of teacher and learning theory, it is to be noticed that overall there are a few mentions (dot size) on this pedagogical horizon, while the *constructivist* perspective finds more instances and is closer to the main focus of the whole discussion.

Indeed, the centroid of the discussion (little square in Figure 2.4) would suggest that the *constructivist* dispositional horizon for education is close to the core of the whole model of Italian student-teachers' first round interviews. This might suggest that the interviewees were really engaged in pedagogical beliefs entailing educational experiences tailored to pupils' characteristics and their active role in the construction of knowledge.

AFTER MULTIPLE ACADEMIC EXPERIENCES FOR TECHNOLOGY INTEGRATION

The present research was also interested in how student-teachers would describe their dispositions towards ICT integration after multiple experiences with TPCK-informed instructional design and the completion of the germane university course (§B-Chp.1). The findings from the post-questionnaire and the qualitative evidence gathered on the topic after the second design cycle will now be described, for the Italian case study.

An ANOVA on the pre- (N= 164) versus post- questionnaire (N= 199) suggested that in the latter Italian student-teachers scored significantly different in several areas, namely: *higher order digital applications and software* (*p*= .000, *d* = .5); *university active role* (*p.* =000, d=.6); *self-efficacy* (p. 000, d.=.5) and *TPCK in teaching practice* (*p.* .000, *d.=1.0* – see Figure 2.5). The mean for the first factor increased from $\bar{x}$=1.5 (σ=.55[62]), to $\bar{x}$= 1.8 (σ=.58) with an intermediate size effect[63] (Cohen, 1988) suggesting that respondents would rate themselves a bit more familiar with educational technologies' use, albeit the final score still figures quite low on the scale. Italian student-teachers also seemed more pleased with their *university's actions* to support ICT integration, slightly increasing their appreciation from $\bar{x}$= 2.8 (σ= .79), to $\bar{x}$= 3.3 (σ =.65). These are not strictly dispositional factors, but still account for some changes possibly fostered by the academic course and design experiences occurred, which purposely included at least the exposure to digital educational tools for technology integration.

[62] For the initial scores on the Italian *knowledge of ICT use*, *access* and *contextual support appreciation*, please see §B-Chp.4.2.4.
[63] A size effect *d* = .5 like this one still figures under the "desired effects" in Hattie's (2009) classification for educators.

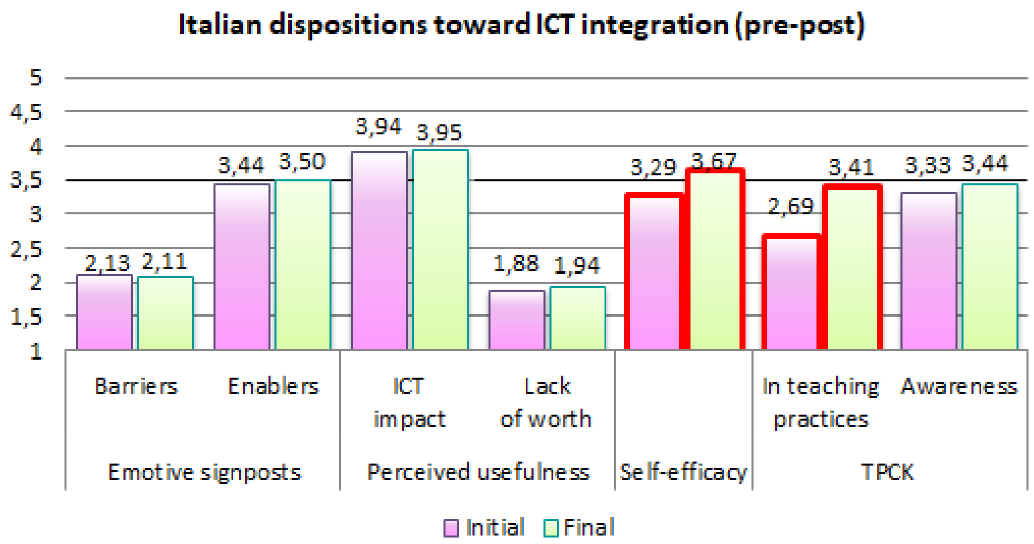

Figure 2.5 Italian participants' dispositions in the pre and post questionnaires (Means).

Participants' *self-efficacy* significantly moved from $\overline{x}$= 3.3 (σ= .85), to $\overline{x}$= 3.7 (σ =.58). Still just mildly above average by the end of their university course (see Figure 2.5), Italian participants' scores changed by a desirable size (Hattie, 2009).

When talking about *TPCK* as *practical* integration of pedagogy, content and technology, Italian student-teachers significantly increased their self-assessment from $\overline{x}$= 2.7 (σ= .77), to $\overline{x}$= 3.4 (σ =.60), with a very large size effect (Cohen, 1988). These participants' perception of capability to enact content – based, pedagogically – oriented, technologically – integrated practices meaningfully improved, although it got them just above the middle of the scale.

On background measures, no other meaningful differences were scored on the areas of perception of *contextual support*, *knowledge* of and *access* to most *common technologies* or the *internet*[64]. Overall, even changes in *emotive signposts* and perception of ICT usefulness (*impact* and *lack of worth*) were not significant[65]. At the end of the course, after multiple experiences with TPCK-informed design tasks, Italian student-teachers still felt mildly comfortable (*enablers:* $\overline{x}$=3.5, σ=.72) in using technologies in education, with just a slight discomfort on it (*barriers:* $\overline{x}$=2.1, σ=.75). They perceived quite well the many potentialities in ICT educational uses (*impact:* $\overline{x}$=3.9, σ=.55) albeit a little scepticism remained (*lack of worth:* $\overline{x}$=1.9, σ=.55), and their overall *TPCK awareness* maintained a mean score just slightly above the middle of the scale ($\overline{x}$=3.4, σ=.77).

Interestingly, from the qualitative data emerges that nine Italian student-teachers, after their second (N=15) design-cycle, would clearly mention being meaningfully more confident in and open to integrate technologies because of the course and/or experiences with the design task:

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[64] Once again, for the initial scores on the Italian *knowledge of ICT use, access* and *contextual support appreciation*, please see §B-Chp.4.2.4.

[65] Although some of these factors actually scored statistically significant, their effect size was usually so small as to make it not meaningful (Cohen's d effect size considered in the present research started at the "small effect" threshold of .3 – Cohen, 1988).

- ✓ "now I feel ah maybe not so sure but maybe just more interested in using technologies so maybe I don't feel so competent but I'm more aware" (IT2b);
- ✓ "before this I thought that technologies were not a good idea actually, but thanks to this lab I changed my mind" (IT4b);
- ✓ "I'm less scared now to try, because at the beginning I thought that if I did something wrong the computer would explode and [now] I know that if one day I want to use them [i.e. technologies] in my lessons I don't have to be scared" (IT5b);
- ✓ "I always imagine myself as a teacher in a traditional way because I don't use computer very much, but for doing certain things I need a computer, so I think also in class when I will be a teacher, I will use it. In these months I discovered some technologies which I didn't know them before, I didn't know they existed, and I think they can really be amazing resources for teaching also because these instruments […] can help children" (IT6b);
- ✓ "now I have more instructions and more instruments: before, I would say 'yes, computer is something to be used because of society required it' but now I know how to use it with which apps, which software, which potentialities they have and so I know how [...] First of all I will see [if by] using or not using this app I would improve the [content related] knowledge of the students the same way or not, so: if it's the same way or better, then I would use it, if not I won't consider it. If it's the same I would go…I would watch if for instance the app is more…not funny but like attractive for the students so if they have the same level of concepts and knowledge and one is better than the other because it's more attractive for instance, I would use the app for instance" (IT8b);
- ✓ "I think that it [i.e. my view on technologies] has a change because now when I have to create a project [i.e. a lesson unit] I think about technologies, and I didn't before… like […] now when I start I think 'ok can I use a technology? Why not? Why yes?' " (IT10b);
- ✓ "previously I think that I will not use technology ah because [I think that] student have even too much contact outside school, with technology but…now it's [still] true, but using technology for education it's completely different from technology for all the day [i.e. every day, personal use]" (IT12b).

Whereas several of the single factors' means did not significantly change, as described, something changed in the patterns of answers of the participants. In fact, when looking for Beatrice, it appeared that she was not the typical Italian student-teacher anymore, as a discriminant function analysis on that very clustering strategy would result correct only for 19.8% of the post-questionnaire respondents[66]. To further investigate modifications between the beginning and the end of the student-teachers' academic journey for technology integration, multidimensional scaling and network analysis were used once again.

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[66] For further details on this analysis and the emerging new profile of respondents, please see §D – Chp.2.

It will now be observed the post-questionnaire multidimensional scaling (Figure 2.6), and second-round interviews'[67] codes mapped through the Epistemic Network Analysis software (ENA – Figure 2.7), in terms of clusters of items and codes, and modifications through time.

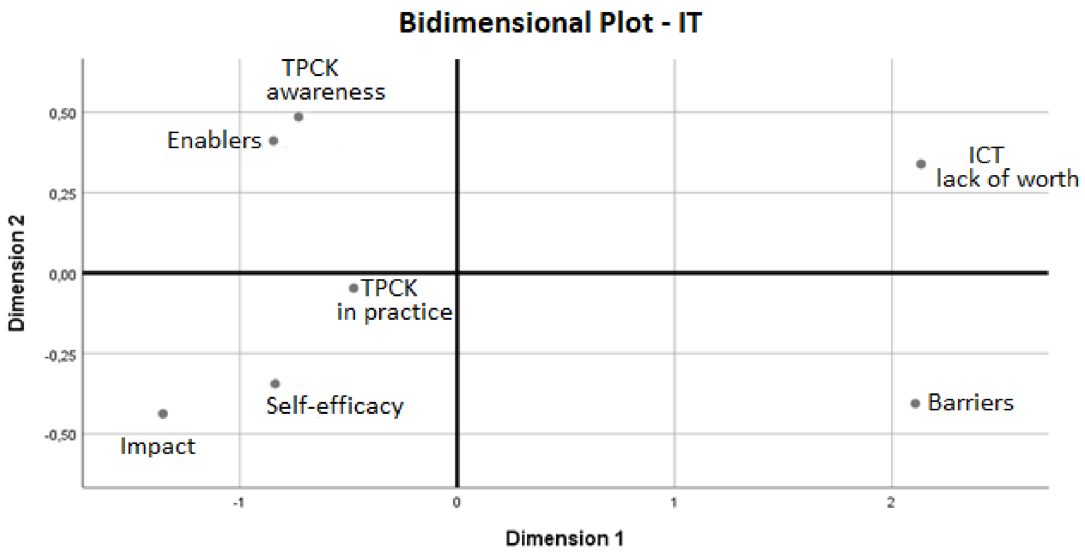

Figure 2.6 Italian post-questionnaire respondents' dispositions (multidimensional scaling, N= 199).

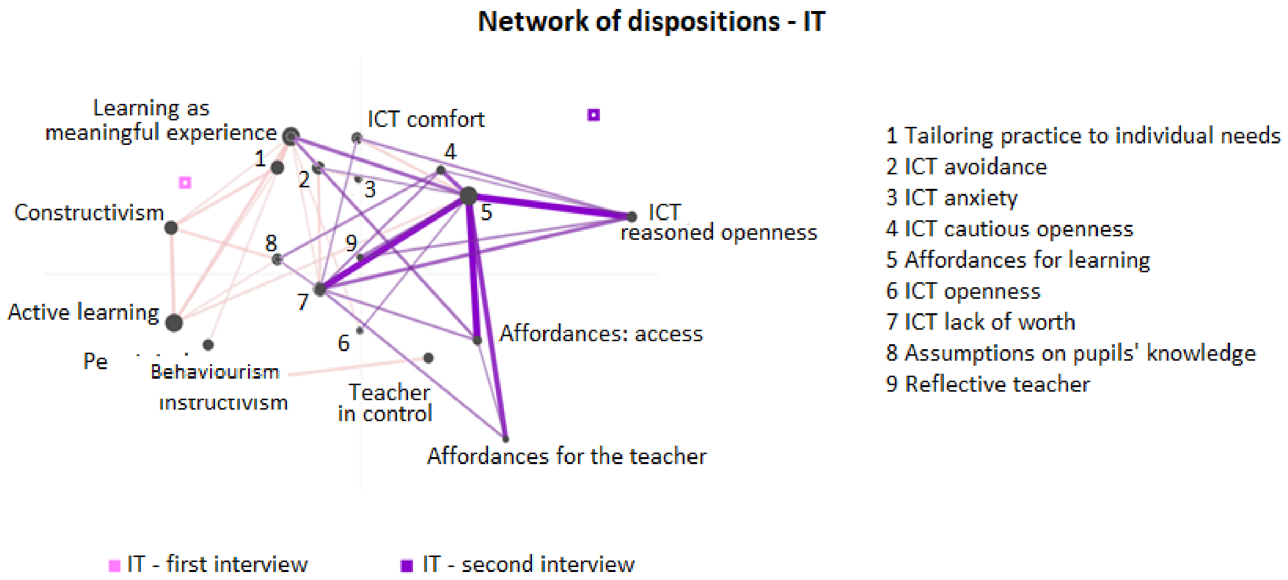

Figure 2.7 Network of dispositions - IT first and second interviews (connections among codes).

Figure 2.6 shows already some interesting modifications in Italian responses, as measure of *TPCK in practice* and *self-efficacy* became closer to each other, joined now also by *impact* which moved greatly on Dimension 1[68]. *Enablers* and *TPCK awareness,* still clustering as before, now shifted further from the other factors, while the cluster of *barriers* and *lack of worth* is more and more peripheral in the picture. From this figure it could be inferred that at the end of their academic

[67] N=15.

[68] It is to highlight that a one-dimensional plot revealed how Dimension 2 was still predominant.

journey for ICT integration in education, Italian student-teachers see an association among their theoretical awareness and overall positivity in addressing the issue, while when it comes to practical considerations, their self-efficacy and the perception of impact are close to their pedagogical-content-technological considerations.

A similar positive nucleus could be noticed in Figure 2.7, where instances of *affordances for learning* (as indicator of *impact*) are strongly linked to the ones on *ICT reasoned openness* (interpreted as *TPCK* related disposition), e.g.: "sometimes technologies is a good way to learn and sometimes it's not […] it depends on the topic and also the students, because [a teacher has] to know students and their way of learning and how they work together" (IT4b); "[technologies] make kids have fun, which is a way to keep motivation, a way to manage the classroom in an active, positive way while if you stay always at your desk with your book it is boring" (IT6b).

Interestingly, the connection among *ICT lack of worth* and *affordances for learning* still maintains importance, e.g.: "I think technologies are not able to do what a work made with hands can do, for the understanding" (IT4b); "children just break them [i.e. technologies] because they are not suitable for a child that is 4 or 5 years old" (IT13b); "in small kids [working] with digital technologies in our minds cannot be used so much, [pupils] have a different approach knowledge" (IT11b). This might suggest that Italian student-teachers still maintain some scepticism about the worth of ICT integration, focusing their concerns on the impact of these tools in transforming the learning experience to the benefit of the pupils.

Furthermore, second-round interviewees would make less comments about *learning as a meaningful experience,* although connecting it now to *affordances* for *accessing the content* (e.g. "we can show the imagine of the street art, we can show a video of street art for the requalification of a city and [pupils] can define, can think [about] their project of street art for their own city" – IT9b).

The idea of *teacher in control* has lost power while a new concept of teacher arises: a *reflective* one who ponders the impact of his/her actions on pupils' learning (e.g. "when [a teacher] decide what [he/she] have to do, decide also what methods [he/she] want to follow so like I thought of the content and when I see that some methodology doesn't work with them [i.e. the pupils] I have to think about something that I can change" – IT10b; "[as a teacher] I have to adapt to the children" – IT13b).

Several other knots seem to have lost importance in the second-round interviewees' words, like *constructivism, active learning, peer tutoring*[69], while the centroid of the discussion (purple square) moved towards *ICT reasoned openness, affordances for learning, ICT comfort.* This might suggest that the interviewees this time were more engaged in technological-related dispositions

[69] It is to highlight that for analysis and visualization purposes, ENA minimum threshold was set at 0.3, showing only the strongest connections among codes, relevant for the whole population of interviewees. Even the codes not connected with others were, this time, hidden.

entailing educational uses of technologies to the service of learning and teaching, in consideration of the content too (as per the strong connection with *access*).

2.3 Sub-question 3: PR shown in TPCK-informed design tasks

The third research sub-question (§B- Chp.1) investigated student-teachers' pedagogical reasoning when performing TPCK-informed design tasks. These were observed twice: when participants were at their first experience with this kind of task, and after they had multiple experiences (i.e. two). Data was collected through focused interviews (Cohen et al., 2007) with a semi-structured protocol (§B – Chp.3.3), each one lasting 30 to 45 minutes per participant, per session.

In the next paragraphs the findings for this research sub-question will be introduced considering both the first and second design cycles. First, the most and least mentioned reasoning dimensions will be reported using as lens the PR adapted model already described in §B-Chp.3.1 (Picture 2.3). This, to better detect any match between the reasoning instances shown and the task procedure's possibly intended ones.

Picture 2.3 PR adapted model in design tasks.

Then, it will be reported how participants would talk about the teacher and pupils' roles[70], technology's role, and any coherence or link among the different decisional turning points mentioned. To do so, the ENA software for data visualization will be used. Finally, and to further approach the core of this research, it will be described if and how student-teachers recognized a connection among their concerns and decisions when performing a technology-enhanced design task, and their given guidelines.

[70] Although these could rightfully be considered instances of pedagogical beliefs (hence considered in the second sub-question), in this section only factual and situated descriptions of roles are considered, as clear intentions/decisions for action.

AT THE BEGINNING OF THE ACADEMIC JOURNEY FOR TECHNOLOGY INTEGRATION

Once completed the first design cycle, Italian student-teachers (N= 16) would mention concerns relatable to several reasoning dimensions, although providing different explanations. Figure 2.8 displays the percentage of interviewees mentioning to have thought about issues connected to the PR dimensions.

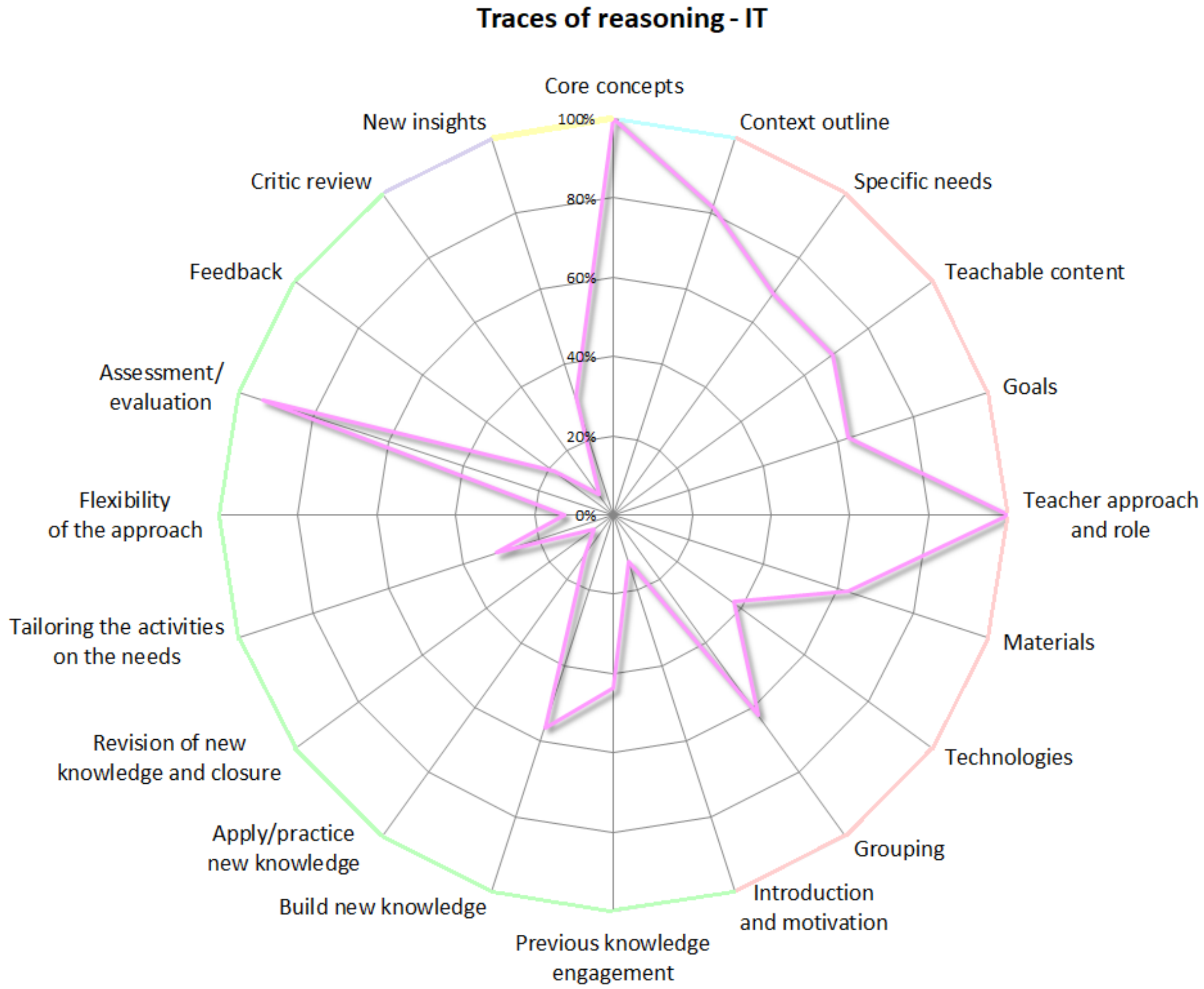

Figure 2.8 Traces of reasoning - IT first interview (frequencies).

From a first look to the figure, it seems the participants would deal mostly with *subject matter comprehension* (light blue wedge), then dwelling differently on the steps of *enabling connections – transformation* (light red wedge), with apparently lower interests for *teaching and learning* steps (light green wedge) apart from a peak in *assessment* related reasoning. Finally, *reflection* (purple wedge) and *new comprehension* (yellow wedge) both find little ground in Italian first round interviewees' words.

Going more into detail, every interviewee would allude to the importance of pondering on the *content* of the learning unit they designed. In most cases, the broad discipline and/or specific content were the first information participants would disclose when talking about their first cycle design products. Some (25%, n:4) would mention just the discipline (e.g. "it was about geography" – IT5a), without going deeper into their understanding of the core concepts but leaving the specifics for the description of the activities. Here, they would talk about the topic more in terms of pupils' doing than of expert understanding, e.g.: "history and […] it was something about the difference between ancient games and modern games, materials, ways of use… and they [i.e. pupils] constructed a ball or a doll like the Egyptians and then they tried to use it how it should have been used many years ago so it was about the comparison between materials and games and so life in the ancient Egypt and now" (IT8a). Many others (75%, n:12) would explain further their understanding of the chosen content: "we decided to do a work about abstractionism and we connected relationships so emotions and colours and we did that through abstractionism through the art" (IT4a); "[it was about the body, we wanted pupils] to study their own and reflect about parts of their body, and the movement that they can do with it" (IT7a). Sometimes they would relate the *content* understanding to the definition of *goals* (e.g. "[we talked about] knowledge of the world and in particular the capacity, the ability of the children to follow a path with verbal indications" - IT10a), or to a conception of learning "we choose the wood [as a topic], seen in the 4 senses so sight, hearing, smelling, and touch because we think that in art it's important that children experiment what they are studying" (IT13a). The connection to the National curriculum is also apparent in some of the interviewees' reasons for choosing the specific content (13%, n:2), for example "a goal of the *Indicazioni Nazionali* [National Curriculum] is that the kid has to understand that he or she has a personal history so like a biography, and also a history of the community, so we chose to do that" (IT3a).

In the *enabling connections/transformation* dimension (light red wedge), it emerged a quite broad tendency to ponder over the characteristics of the *context* in its *outline* (as time, location, and equipment) and *specific needs* (as pupils' cognitive/physical/emotional characteristics and learning needs). Italian interviewees seemed particularly interested in understanding the socio-cultural and linguistic background of their students (63%, n:10), for example: "there are children [..] not only from Italy but from different countries and different familiar contexts and so I think that […] I have to be aware of this in my planning, I have to keep open a lot of doors to achieve the same goal [with] very different streets" (IT1a); "you have to know the background of your students, where the school [is] situated and if there are foreign students…there are a lot of aspect that we have to consider during the creation of a lesson" (IT12a). Participants (38%, n:6) would also mention the connection between the *contextual* characteristics and the definition of *goals*, e.g. "when I see the context and the environment of the students I must think about the characteristics of the students also for the objectives, the goals because yes, there are general goals but I must see what goals my students can do or need [to] do, and also [I need to consider] the time because some are faster and some slow [but I want them to get to their goals]" (IT9a).

How the *teacher* would *approach* the educational experience is an issue dwelled upon by every interviewee, with different specifics. A few (13%, n:2) would consider the need for the teacher to establish an emotional/relational bond with the pupils (e.g. "I know it's a lot about the feeling, how you make me…you make the students feel, how teachers feel, so you can broadcast also the love or the hate for a subject […] I will open all the possible doors and try the most original things to catch the interest of everyone" – IT2a). Other interviewees would show a quite clear polarity between a teacher approach strongly centred on the teacher (e.g. "we use a classic lesson, frontal [i.e. a lecture] for reinforce the content"– IT12a; 25%, n:4) and one putting the pupils in charge of the learning experience (e.g. "the teacher is a helper [when pupils are] doing jigsaw and it's more like a consultant so it's a kind of a guide but less important, because children have to learn and to learn by themselves"– IT4a; 25%, n:4), sometimes even abdicating at any accountability (e.g. "I think that they should try and if the play begin and […] they do what they want [but it does not work as I thought], probably then the teacher say "change roles" maybe they will get luckier and find someone that talk with them and give directions" – IT15a). The vast majority of participants (83%, n: 13) would go into details about *teaching approaches*: "[I had to think] of the format and the strategies and the techniques, and maybe methods, but I think […] I found something techniques as well as the format I could use, some that could be useful or maybe I could test" (IT2a); "I will use the modelling technique so at the beginning the teacher helps them [i.e. pupils] out a lot […] but she also leaves them alone doing what they have to do…but it has to be incremental" (IT3a); "I think that the way [I] used the formats, the techniques used are good enough for this kind of topic" (IT11a); "we analysed all the methods, formats, strategies…and we changed completely our mind, to make it feasible for them [i.e. the pupils]" (IT13a).

Interestingly, *technologies* were not a concern for too many student-teachers when creating their design product (mentioned only by 38%, n:6). Reported reasons to not dwell on the issue were sometimes related to the irrelevance of ICT in the imagined learning unit (e.g. "I don't really see a use of technologies in the program we did…it is enough as it is" – IT5a), but most of the interviewees (63%, n:10) would relate their lack of thought about the matter to the task requirements (e.g. "in this case no [I did not think about the use of technologies] because they told us that it was a topic of the other workshop in January" – IT10a; "no, [I did not think about technology use], this is something we come to work hard in the next lab, it will be a good challenge" – IT11a). As the reader might recall from §Chp.2.1, in the first design cycle student-teachers were not explicitly required to embed technologies, although they were free to do so. A more technological focus was enacted in the second design task.

The interviewees who would indeed mention the need to think about technologies in their design process reported uses for improving comprehension (e.g. "with the technology it [i.e. the topic] would have been clearer and maybe everyone could have experienced it, because if you give the program [i.e. the software] to [the pupils] to work at home with their parents, they could improve their knowledge I think"- IT1a), access information and visualizing content (e.g. "we will use technologies to show them [i.e. pupils] some mountains or places that they probably didn't know" - IT6a), or to change the learning experience altogether (e.g. "I think [pupils can take pictures of] plants or things that they can find interesting so when they finally end all the activities, the teacher can give them [the] photographs and they can see what they have done, and another thing is we have them record sounds so [in class] for example when children are [presenting] "this is the humming bird" or an animal, they can hear it too, so they can understand it better with the 4 senses, that is the main focus [for] the lesson […] and when we go to the woods with children we can also give some of them, some video cameras so they can photograph birds that they cannot take to the class […] and from the photograph the teacher can work or she can print them or she can [present] them later" – IT13a).

When moving to the *teaching and learning* section (light green wedge in Figure 2.8), every participant would take time to think about *assessment,* some mentioning summative evaluation strategies (e.g. "we based our evaluation, our judge ah on the observation, on the dialogue and on the observation of the final performance" – IT2a), others formative ones (e.g. "we thought about [ongoing] evaluation and not final…we decided to evaluate the attention and how they work in group and how they collaborate and how they participate during the lessons" – IT12a). Interestingly, many interviewees (44%, n:7) would talk about assessing the pupils' learning when prompted with the question "can you give me an example of your pupils building new knowledge on the topic?", e.g.: "when they draw what they've learned from the last lesson we thought that through this way we can see if they've learned something" – IT4a; "when [pupils] test themselves touching the [required body] part or the child shows to the whole class where to put the image [of the body part] on the poster [of the body], on the right place, it's a moment to change the knowledge of the children" – IT7a.

Furthermore, in Figure 2.8 it seems that not so many Italian interviewees would report clear decisional processes dealing with classroom-based activities (*teaching and learning*), but the figure is actually misleading in this. Every participant would list the activities they planned to perform with their pupils, but their description would seldom discuss further the reasons why they chose an activity over another, especially in terms of *engaging previous knowledge, apply/revise new knowledge* (e.g. "[we thought about] 5 activities: we started with a song about left and right, then we had a kind of poster for left and right with kids' hands, and then we put them [i.e. left/right handprints] in the class" – IT16a). Nevertheless, many interviewees (56%, n:9) would indeed mention deeper consideration on the *knowledge building* process, for example: "we planned different activities for them, starting with the familiarization with the concept, with a song and then we made some papers for them with the use of their hands so maybe with their body they could experience more the concept that we wanted them to know, and then we made them play with the concept so…I think that we made them understand the concept but not only with their bodies, also with their eyes, with different strategies" – IT1a; "maybe if they have different starting knowledge we could try by what they already know and make it physical by the making something with their hands or their mind and maybe I could base the [next activity] on their re-think of what happened" - IT2a; "first [we wanted the pupils] to observe the shapes that surround them and understand they're real figures and then give them a geometric name and geometric features…but start from them [i.e. the pupils], because all around us there are geometric figures and they don't understand this yet" – IT14a.

When looking at *reflection* and *new comprehension* (respectively purple and yellow wedges in Figure 2.8), low to none reported mentions was found in Italian student-teachers' interviews. When it comes to *new insights* interviewees could refer to the impact of this design experience on their self-confidence in creating and implementing the design product described (e.g. "We have programmed it, we have planned it but we haven't really done it [in class] so I think it lacks the last test" – IT4a), or to true new understanding of the design process itself (e.g. "[to have to create the lesson made me] understand how children react to different techniques and how they could understand it [i.e. the topic] more and better" – IT1a). Just one student-teacher openly reflected on their design product critically: "I think four lessons one after the other are not good because we can put them like one lesson a week, not all in a week because little children can… it's too intense. So, I think maybe I could change this [of my plan]" (IT13a). It is to highlight that the design products were not actually implemented at school, thus lacked a real-life feedback that could spark such two reasoning dimensions.

Italian student-teachers' first round interviews were mapped through the Epistemic Network Software ENA, to better visualize the focus of these conversations and the strongest connections among the issues addressed. In Figure 2.9 can be retraced, by the size of the dots, the mildly high frequency of mentions of reasoning related to *content* (3), *assessment* and *build new knowledge.*

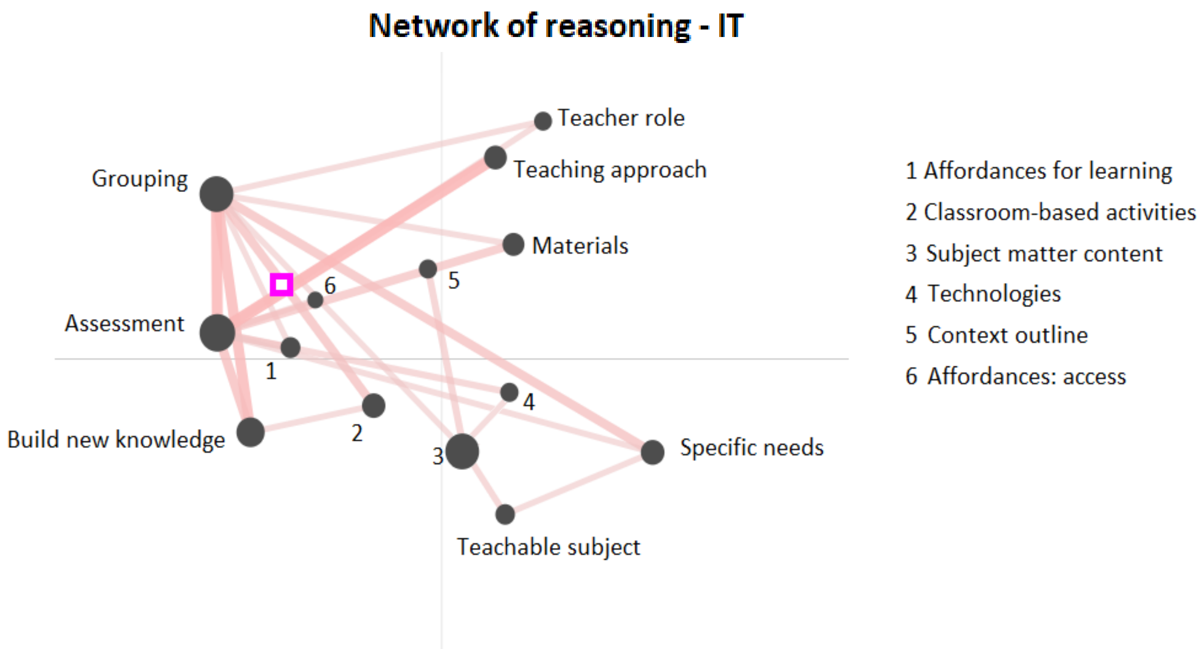

Figure 2.9 Network of reasoning - IT first interview (connections among codes).

The figure highlights also how concerns about individual/*social* dynamics of learning were expressed by 63% (n:10) of the first round interviewees (see also Figure 2.8), with instances like: "maybe some students probably don't know what is the snow or the mountains and other students can help them in this, imagining the situation the context of the story" (IT6a); "in groups you can try to see more ideas and so if you are wrong or you have some misunderstanding it's more simple for you to understand what did you not understand" (IT8a); "[when] working together the singular idea become a nice idea, a best idea, for example, or an idea of one person is improved with another person" (IT9a).

What is most interesting in the ENA network is to see the lines connecting the different knots, and their distance one from the other (indicating a different role in shaping the model). First of all, it appears that the thickest lines join *build new knowledge, grouping* and *assessment,* which also connects to *teaching approach* and *role.* This suggests, as anticipated through the quotes above, that when interviewees talked about processes to build new understanding in their pupils, they closely connect strategies of evaluation and perceive the need to define the teacher's approach in every step.

Another strong connection is the one linking considerations of pupils' *specific needs* with the ones on *grouping* strategies, the former also related to making the content accessible (*teachable* *content*), to suggest some sensitivity of the interviewees for the characteristics of their educational environment, although there is no instance of *tailoring practice* in Figure 2.9.[71]

Finally, the centroid (little square in the picture) would suggest that the overall focus of the Italian participants' first round of interviews is definitely gravitating on the side of *assessment* and resources' *affordances* for *content access*, indicating how these two reasoning dimensions weighted heavily in shaping the first interview discussion.

Besides investigating the participants' PR characteristics, the major interest of the present research was to understand the role of the given task guidelines in shaping these (as per main research question - §B-Chp.1). Considering the frequencies of the reasoning codes, Figure 2.10 shows the percentage of interviewees who would clearly connect the mentioned reasoning step to their task (green bars), and the ones who would firmly deny any relation to it (orange bars).

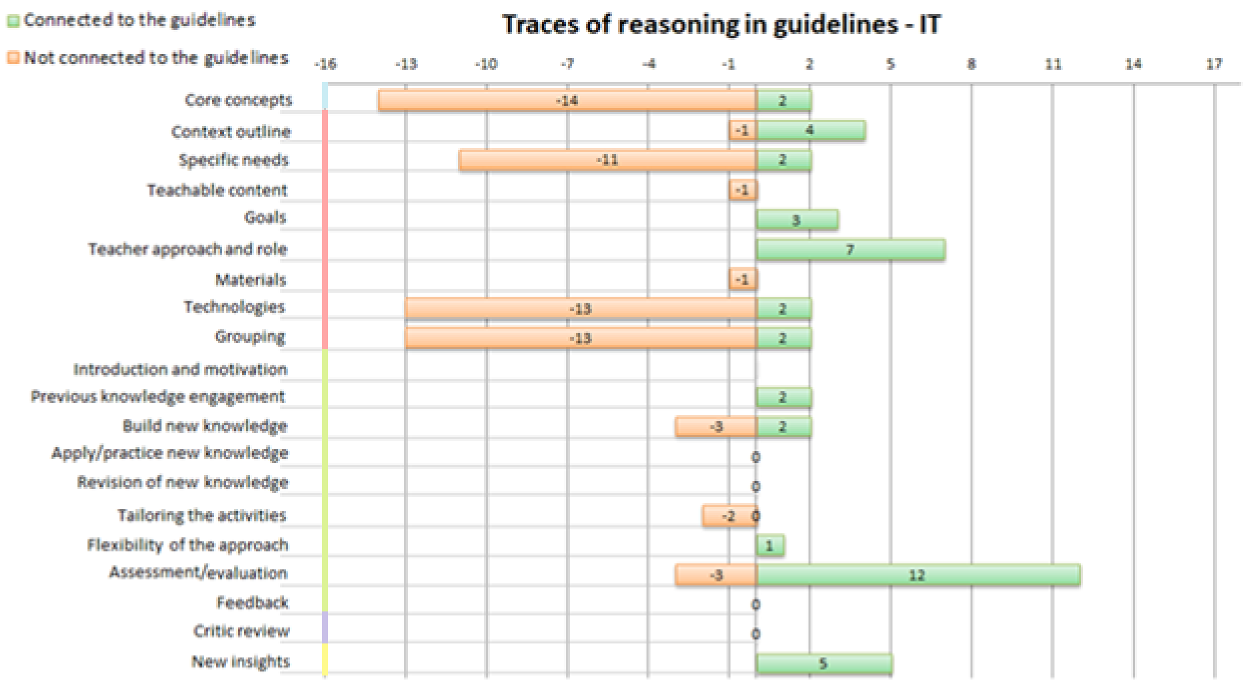

Figure 2.10 Traces of reasoning in guidelines - IT (frequencies).

At a first glance guidelines seem to have not been perceived really determinant in the decisional processes to design a technology-enhanced learning unit. Quite to the contrary, while on some dimensions respondents would not express a clear judgment (i.e. *apply/practice new knowledge, revision of new knowledge, feedback* and *critic review*), on many others they would firmly state that their guidelines did not deal with the issue. Examples of the latter comments could

[71] For analysis and visualization purposes, ENA minimum threshold was set at 0.3, showing only the strongest connections among codes, relevant for the whole population of interviewees.

be: "they didn't really ask use if we knew the topic, they assumed it I think, or maybe they assumed that we could deepen it by ourselves" (IT1a); "no, they didn't ask to think about the needs of my students" (IT14a); "in these guidelines there were no technologies and by doing this [task] we did not think about it [i.e. technologies] because it [i.e. the lesson] was quite crafty" (IT8a); "[about grouping] we just told that, they didn't ask that" (IT16a).

The Italian interviewees who would indeed find some connection between their task and the decisional turning points they experienced, would comment for example: "they have the students with different ethnicity and also background and the fact that they have different social extraction here in the context [points at IDP 1]" (IT10a); "at the beginning you have to divide, you start from objectives [points at IDP 2] and then you have to split it in contents [points at IDP 4], knowledge, skills [points at IDP 5]" (IT8a); "using different methods or formats or techniques…[you think of that during] all of the last part of the chart [points at IDP 6 – 6.4] when you have to choose how to teach" (IT9a); "in all the activities we had to made, they said: 'at the end remember you have to give and evaluation' and yes it's the last here [points at IDP 11]" (IT5a).

It is to highlight that this interview round took place at the end of the first design cycle, so issues of familiarity and understanding of the guidelines could have played a role (see §Chp.2.1).

AFTER MULTIPLE ACADEMIC EXPERIENCES FOR TECHNOLOGY INTEGRATION

Completing the second design cycle, Italian student-teachers' PR mentions shifted on several dimensions. In Figure 2.11 it can be seen how the interviewees' reasoning quotes changed from the first (pink) to the second (purple) round of interviews. Before going down to the details of the changes, the reader should be reminded that in this second interview participants (N=15) were not guided in any possible reasoning or design steps, but simply asked what they thought necessary to consider or keep in mind, when preparing a learning unit.

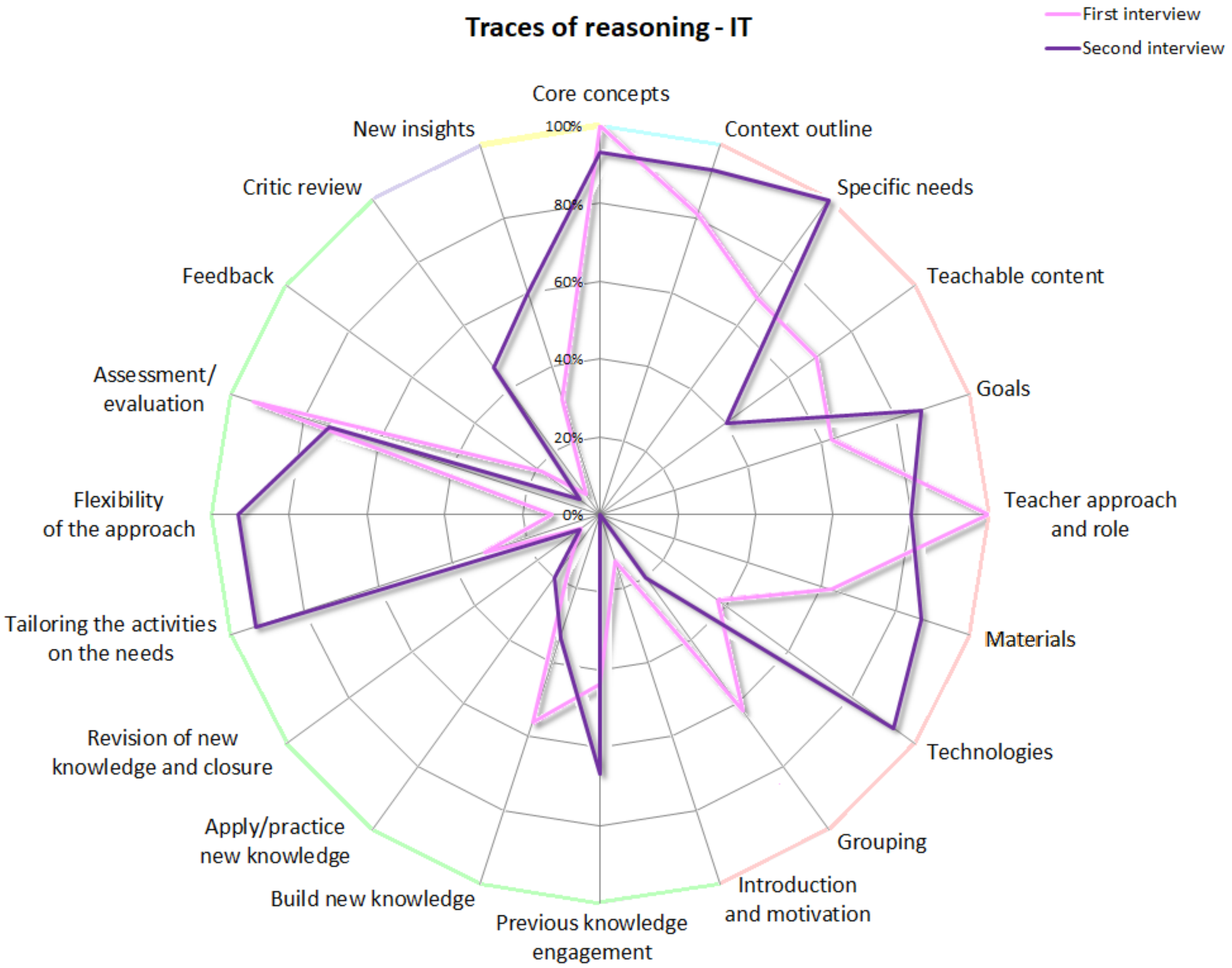

Figure 2.11 Traces of reasoning in time - IT (frequencies).

At a first glance, Figure 2.11 would suggest a wider engagement of some PR dimensions, after the second design cycle. Particularly important seem the increased comments on the exploration of contextual *specific needs,* mentions of *technologies, tailoring,* and *flexibility,* with an increase also of the *critic* self-*review* of interviewees' work.

When free to talk about what perceived essential to be addressed and reasoned through in an instructional design, regardless of their design product, the *comprehension of subject matter* still holds a primate for Italian student teachers. Interestingly, while they would mention the need to define the broad discipline and topic to address, they talked about this choice not in terms of personal/professional expertise on the matter, but of context sensitivity. They would consider how the other disciplines are treated in that school (e.g. "[I need to know] if they made some specific activities about I don't know Italian, foreign language…or some creative activities" - IT5b; "I ask [about the] activities of other subjects for know what the students do during the year" – IT9b); or how the very discipline has been addressed before (e.g. "I think quite [important] not for the concept itself but maybe for the specific words and maybe because …it's quite strange but they think that little children cannot comprehend so much, but maybe they can! So, I think if their teacher when they were little children has taught only some part of the topic, maybe in the last year [when I come in], they could study it again more deeply, so I need to know what kind of projects did they do" – IT2b).

In *enabling connections – transformation* (red wedge), the exploration of the *context*, both in its physical setting and outline, and in the pupils' possible characteristics, seems to gain more and more importance: again, in relation to the choice of content (e.g. "I would like to know what part of history they did last so we would do new topics, new contents in order to learn something new" – IT4b; "when you program you have to know if there are some [topics] that it's better not to address because some students can be hurt" – IT12b), to the presence of *particular needs* (among many others, "[I want to know] if there are any particular cases in the class like children with disabilities or something like that" – IT1b; "[I need to know] how they interact with the others, their [cognitive] levels but particularly if there's some special needs" – IT10b), or the broad contextual background ("I want to know if some events that happen in their local reality, like local history or some happy or sad events that happened to one parents or friends or something else, [so] I think that I can give them the right input to think about it and make them have their own thoughts and opinions" – IT2b).

Although Italian interviewees seem really sensitive to the contextual characteristics, both when choosing the topic to address and *tailoring* the activities (as the reader will see shortly), they dwelled less than before upon the actual ways to make the content more accessible (*teachable content* - 40%, n:6). Their comments on the teacher's actions focused more on concerns about how to best settle into the pupils' established routine (e.g. "I have to know if the [regular] teacher uses something particular during her or his method, […] because let's say the [regular] teacher uses the frontal lesson method [i.e. lectures] … I don't know if I can change that, in a way children would be kind of scared" – IT1b; "I will ask to the teacher which approach she or he used in class so I can give continuity to the students" IT6b). On the other hand, rare were this time the mentions of technical terms like "format", "strategy", "technique" (for the *teacher approach* step), whereas several comments bent towards the *tailoring* issue, for example: "I think that a teacher should cover all the forms of knowledge possible with her methods, so that every student who has different features and different needs is helped" – IT3b.

When it comes to *technology* use, a great improvement in frequencies of mentions appears, starting with the concern for technological equipment in the school (mentioned by 47%, n:7 versus the 0% in the first round of interviews). Comments on the actual reasons to use technologies related to the relevance for pupils' content learning (e.g. "I ask myself about technologies, which one could make some differences in the [pupils'] knowledge of the topic" -IT5b; "[we wanted to use] technology to make more practical the knowledge" – IT12b); "technologies were something more but it wasn't like they would really change the message or what we had to do" -IT6b); and to the possibility for pupils to be active users (e.g. "we made sure that children could use them, so for example with the LIM, we made sure that they could change the position of the elements of the story, or with the coding activity we made sure that they could actually touch the support, we made sure that technology didn't have anything to read because they can't yet, so we worked with images, so it was something affordable for them" – IT3b; "we chose Dot storming because according to us it was better for the immediate [communication and share of opinions] which could make all the students participate at the same time" – IT14b). Other interviewees reported affordances for cooperative learning strategies, like "[it is different] working alone or in group … [they are alone] working with the paper or with their hands, in silence, but we can use computers to make them cooperate" (IT8b). Some comments also showed the need for coherence among technology uses and the other decisional steps informing the creation of the learning unit, for example: "before I thought I should start from a topic and then try to find a way to explain it, also with technology, now I think I can focus also on the technology and on the products I can maybe achieve from that technology [first], and then find out my goals or my topics so it's something reversible" (IT2b).

Finally, the individual/social dimension of learning (*grouping)* appeared rarely in the words of the second-round interviewees, more focused on the single students' necessities (see *contextual analysis* above and *tailoring approach* shortly) than on the ways to make them interact.

Moving to *teaching and learning* related reasoning, the greatest modification in Italian participants' words was related to the *personalization* of the learning experience. Interviewees would mention considerations about tailored uses of resources "obviously, if I have different children I can use different teaching methodologies" – IT1b; an approach flexible to pupils' preferences "if there's something that is really important I do it in any case, but if there is something that is not so important, I can decide to maybe do something different if they're more interested in that" (IT10b); and open to emerging conditions "it's important to continuously calibrate what you want to teach and how you do it so that everyone is involved in the same way" (IT12b); "I would modify [my actions] because I think [it is] better if they [i.e. pupils] are involved, interested, [if they are] distracted or I'm not clear, I would change the method" (IT13b); "maybe the technology doesn't work so the [lesson] can't go on, or maybe the explanation of the teacher [i.e. me] is not good enough because maybe I'm too scared, or maybe I'm going too fast for them, or maybe a child is a very good student and needs more topics, more things to learn, and the rest of the class doesn't because they have another way of learning…so you have to consider all these things" (IT4b); "it's different for example if I have 2 hours of history on Monday and another on Tuesday, they are near days so […] I can't say to the children 'ok for tomorrow you have to search something' or something like that because they finish school at half past four so it's impossible, it's no sense so maybe I think another project" (IT13b).

Finally, also *critic review* improved in the second round of interviews, although its related codes were found still in less than half of the total interviews' transcripts. An example would be: "[when a pupil] doesn't understand something, there's a reason because maybe the teacher hasn't explained very well or there are many problems in the class during the explanations or there are a lot of factors, so I think it's important to consider all the things back" (IT4b). It is also to highlight how nine interviewees (60%) would report a *new insight* thanks to the performance of their task: "though this task I think I can teach in a better way, in more significant way the [topic]" (IT7b); or "I think I'm better now at knowing how to choose a technology but I feel like I still need more practice" (IT3b); "after this course I think that [it] will be easier to choose technologies and to integrate it with some other more traditional technologies" (IT6b)[72].

When looking at Italian student-teachers' interview maps from the two rounds through ENA, a shift can be noticed in the focus of these conversations and in the strongest connections among the issues addressed. In Figure 2.12 can be retraced, in the purple-dots size, the high frequency of codes related to contextual exploration of *specific needs, teaching approach* and *tailoring practice.* It can also be seen the slight decrease in the number of comments (hence the in the dot size) of *assessment.*

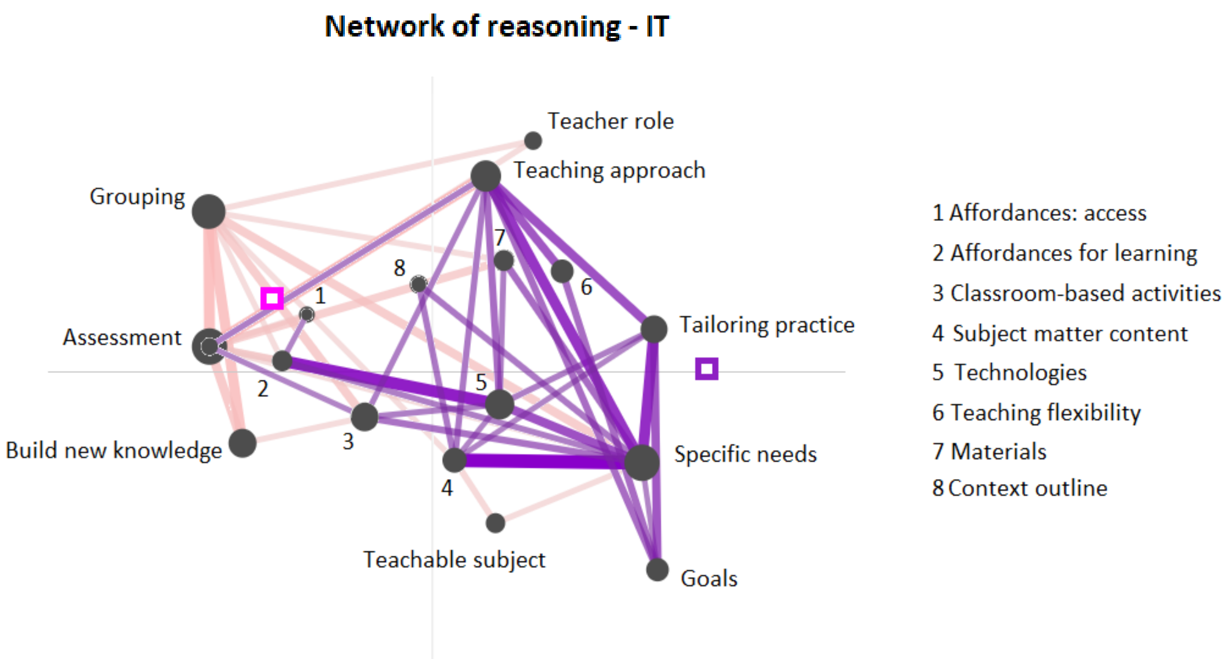

Figure 2.12 Network of reasoning - IT first and second interviews (connections among codes).

Even the strongest relations among codes is changed, in the second round of interviews. The thickest lines – hence heavier bonds – now connect concerns about pupils' *specific needs* with the definition of the *subject matter content,* and *tailoring practice*, as already seen in the quotes before.

Interesting are also *technologies* (5), whose frequency increased from before and figure strongly connected to *affordances for learning*[73] (2), accounting for a pedagogical lens for these

[72] See also Chp.2.2

tools. Examples of this could be: "I think that about the technologies there are the way the children use them and the way they can create their own technologies for example starting from the small objects they have in their home they could have a brilliant idea and using their object" (IT2b); "in our digital storytelling we put the pictures that we wanted and so we shaped the story as we needed it to be [for our pupils] and that was really useful, because maybe the book is already made and so you can't change it and with technology you can shape your content" (IT3b); "first of all I will see after using or not using this app I would improve the knowledge of the students the same way or not" (IT8b).

Other codes became irrelevant in the second interview (considering a threshold of .3 for the network), such as *teachable subject, grouping, building new knowledge and teacher role.* While they still appeared for frequency, they were not connected meaningfully to the other issues, in this round.

Finally, it is to highlight the shift of the centroid of the discussion (purple square), toward the side of *tailoring* and *specific needs* concerns, indicating how in the second round of interviews Italian student-teachers are really engaged in considering these issues to shape their reasoning for a technology-integrated learning unit design.

Once again, along with exploring the participants' PR characteristics and changes, the role of the given task guidelines was investigated. Considering the frequencies of the reasoning codes, Figure 2.13 displays the percentage of interviewees who would clearly connect the mentioned reasoning step to their task, in the first (in green) and second (in blue) interview rounds.

Differently from the first round of interviews, the guidelines-reasoning matching was not carried out through the attribution of reasoning to the guidelines, but from the participants' identification of the guidelines' parts relevant to inform the reasoning. This shift in the prompt question was made to let the participants free to state the importance of the guidelines' items in helping to prepare a learning unit.

[73] This code was considered as indicator of technology impact, within the analysis of student-teachers' dispositions toward ICT integration (§Chp.2.2), it could provide interesting insights on participants' reasoning too. For this reason, when such code (and any other *affordance* one) was attributed to statements of general judgment and belief on the worth of technologies for learning, it was used within the analysis of dispositions; on the other hand, when it entailed some sort of detailed/concrete argumentation on the actual use of technologies in a learning environment, it was considered within the reasoning analysis.

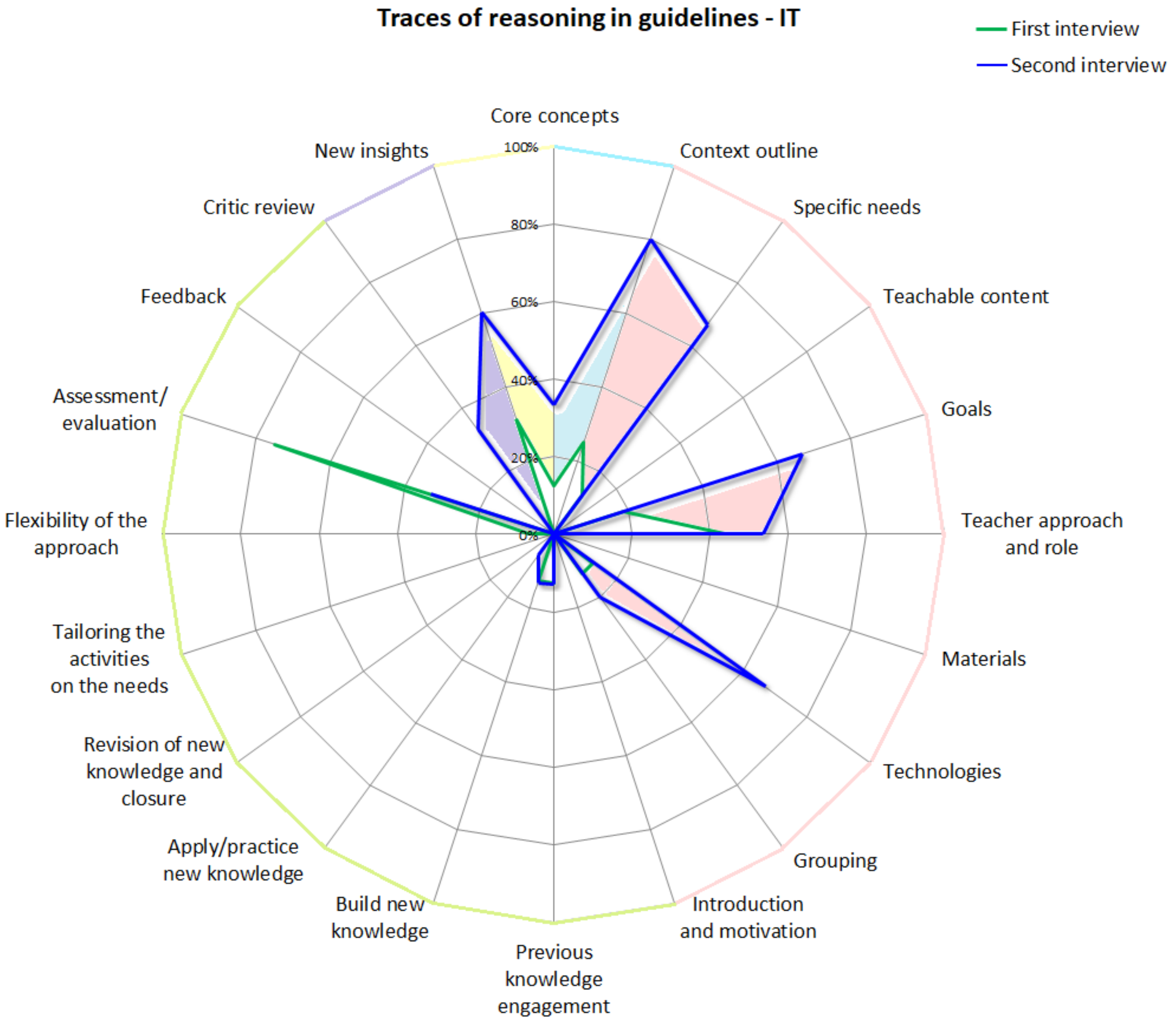

Figure 2.13 Traces of reasoning in guidelines - IT first and second interview (frequencies).

At a first glance, the perception of guidelines' role for reasoning seems to have greatly improved in some areas (coloured in the picture), starting from the *enabling connections/ transformation* dimension.

Interviewees would refer to the guidelines' items to explain how and why they would prepare a learning unit in a certain way, from the *context* exploration (e.g. "to start we have to consider the context, environment and the students we have and to work with [points at IDP 1[74]]" – IT4b; "the first important thing is the context [points at IDP ID 1], environment and students of the school, and from this general context I can find goals [points at IDP 2], timeframe [points at IDP 3], contents [points at IDP 4] and knowledge, skills

[74] As per §Chp.2.1, item one reads "context/environment/students".

[points at IDP 5, drawing one way arrows from item 1 to 2,3,4,5[75]" – IT7b), to the *goals* definition (e.g. "I'm there and what are my goals [points at IDP 2[76]]? My goals are these and I have to understand what are the topics [points at IDP 4[77]], the contents that I have to explain and [have] the children to arrive, to get to the goals [points at IDP 2] – IT14b); to *technologies* (e.g. "the technologies [points at IDP 7[78]] are really important in that part because different technologies can give like different forms…they can develop different forms of knowledge" - IT3b).

Interestingly, the *teacher role and approach* recognition in guidelines slightly increased, but several (66%, n:10) interviewees reported the guidelines to be unnecessarily over-detailed, in relation to the needed thought to give the issue: e.g. "they differentiate [the teaching approach] with different words but I don't know, […] I think that it's easier than that: when you get with the kids […] I don't think about them [points at IDP 6.1-6.4[79]] because really I don't think about format [points at IDP 6.2] when I see kids" – IT1b; "methods [points at IDP 6.1], formats [points at IDP 6.2] and strategies [points at IDP 6.3]…they are important, but not in the classification that I have studied, you don't need to [make them clear] every time" – IT6b.

About half of the second-round interviewees (47%, n:7) commented on a intertwined conception of design components: "the thing is the more you think about it the more you see relationships between ah the [issues]" – IT3b; "I would put contents [points at IDP 4] and where I want to go so goals [points at IDP 2], technologies [points at IDP 7], what's useful in the content and what makes it easier for the children…[with also] teaching methodologies models [points at IDP 6] all together" - IT11b.

One dimension which significantly decreased is the attribution of *assessment* decisions to prompts offered by the task procedure, which more than halved from the first (75%, n: 12) to the second (33%, n: 5) interview round. It is to say that it was also slightly less mentioned altogether, as reasoning dimension, while the second task would stress the role of technologies over other design components (§Chp.2.1).

Moreover, few to none interviewee would attribute clear relevance of the given guidelines when deciding upon making the content *teachable,* which non-technological *materials* to use, or classroom-based activities beyond *assessment* (*teaching and learning* section).

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[75] As the reader might recall from the beginning of this section, during the second interview student-teachers were asked to map the guidelines' items they thought were relevant in deciding how to create a learning unit. Although this dissertation will not deal with the data emerging from these maps, instances like the reported one were selected to further investigate what was perceived essential/peripheral by the participants.
[76] As per §Chp.2.1, item two reads "goals/objectives".
[77] As per §Chp.2.1, item four reads "content/topics".
[78] As per Chp.2.1, item seven reads "technologies".
[79] As per Chp.2.1, items 6.1-6.4 read respectively "methods", "format", "strategies", and "techniques".

Finally, *critic review* and *new insights* improved greatly in the second round of interviews, and were always linked to the task suggesting a possible influence on a more conscious understanding of the teaching profession and the design practice in particular.

2.4 ITALIAN CASE ANSWER TO THE MAIN RESEARCH QUESTION

The Italian case study engaged 199 pre-service teachers who were training to become generalist teachers at (pre-) primary education level (B - §Chp.4.2.1). Within the Italian context, these types of teachers are required to teach any discipline in (pre-) primary schools in realization of the National Curriculum guidelines for pupils' autonomy, identity, competences and content knowledge development (see §B-Chp.4.2.1). Furthermore, the educational policies at national level stress the importance of integrating technologies widely (PNSD, 2015), providing infrastructure and dedicated staff to support digitally integrated teaching practices.

Specifically, the participants (aged mainly 17-22) were attending what they stated being their first academic experience for technology integration in education[80]. The vast majority of them did not have any previous teaching experience, whereas some affirmed having worked in formal/informal education, although not integrating technologies in their practices (§B-Chp.4.2.4). Student-teachers entering the academic course reported wide access to digital technologies[81] but not so much interest in engaging with them. Their familiarity with the use of ICT personally and in education was at best on the middle of a 5-point Likert scale, even when talking about leisurely use of technologies (e.g. social media). Overall, they seemed also sufficiently appreciative of the surrounding encouragement and academic support to integrate technologies in education. This situation changed throughout the course and the two design cycles within, as they became significantly more familiar with educational technologies and conscious of their university supporting role for integration (§Chp.2.2). These results are in line with other researches stressing the positive impact of design processes in offering "meaningful exposure to technology integration in educational contexts" (Baran & Uygun, 2016, p. 48) and enabling (future) teachers to make "informed decisions" on the matter (Conole & Willis, 2013, p. 28).

Along with this increased familiarity with technologies for education, they showed some changes even in their dispositions to ICT integration. Italian student-teachers entered their course cautious about the worth of integrating technologies, compared to the emotive and practical barriers

[80] At least at university level.

[81] Everyone stated to own at least one device connected to internet (§B-Chp.4.2.4).

they perceived (§Chp.2.2). In time, though, they grew significantly more confident and capable to integrate technologies in educational practices, with even nine participants clearly saying that the attended course and its tasks made them more open and positive to integrate ICT. While these are not yet realized behaviours, self-efficacy and attitudes are recognized as powerful predictors (Banas & York, 2014; Scherer, Siddiq & Teo, 2015; Smart, 2016; Tondeur et al., 2017, 2019) for future practice, as "preservice teachers' attitudes and beliefs regarding ICT may indicate the extent and quality of ICT utilization" (Forkosh-Baruch, 2018, p. 427).

Participants' words also showed an association between low self-efficacy and feelings of avoidance and anxiety towards ICT integration, opposed to high self-efficacy mentions related to openness to the matter (§Chp.2.2). At the beginning of their academic journey, even the most self-confident Italian student-teachers would consider using technologies mainly to the benefit of the teacher (§Chp.2.2), possibly because they could not perceive too high of an impact of these tools on the learning experience. That was their main concern, when talking about pedagogical beliefs: initially, they strongly focused on constructivist beliefs and on the value of making the learning experience meaningful for the pupils, although maintaining a controlling position over the whole educational event. Looking at the literature, it seems unusual that constructivist beliefs would not associate with openly positive and learner-centred technology-integrated practices (as in Ertmer et al., 2012; Kim et al., 2013; Kramarski & Michalsky, 2015; Overbay et al., 2010; Sang et al., 2010). Once again, it could be explained by the Italian student-teachers' hesitant appreciation and awareness of educational technologies at the beginning of their academic journey on the matter. Furthermore, as these were initial findings, they could have reflected the ideal of teacher perceived in the precious academic career: a traditional teacher in charge of the educational experience, with a teacher-centred perception of technological affordances (Chai et al., 2013; Heitink et al., 2016; Smits et al., 2019).

Italian student-teachers' dispositions changed through time, making them more aware of ICT potentialities for learning, albeit still wary in their overall approach (§Chp.2.2). At the end of their academic journey they perceived their self-efficacy more related to the (positive) impact of ICT and their practical uses in education. They were more capable of recognizing technologies' potentialities and at the same time more confident in their implementation. Considering that their familiarity of use improved along with their self-efficacy, it could be foreseen an increase in the participants willingness to choose and participate in technology-integrated activities (Kavanoz, Yuksel & Ozcan, 2015; Tondeur et al., 2017). Furthermore, their appreciation of the academic support aligned on this positive trend, reminding of other researches' results about a connection between pre-service teachers' positive attitudes, self-efficacy, TPACK and perceived support by academia (see Tondeur et al., 2016a, 2019).

Participants' conceptualization of a teacher became more reflective and less controlling, with a real shift towards a learning-centred perspective (as in Angeli & Valanides, 2009; Smart, 2016; Valanides & Angeli, 2008). Italian student-teachers would still perceive issues in the worth of technologies for learning, but overall became more interested as they would talk about being more open to and comfortable with ICT integration, and its affordances for learning (§Chp.2.2). Once again, these positive attitudes figure as a powerful enabler of technology-integrated future behaviours (Abbitt, 2011; Banas & York, 2014; Christensen & Knezek, 2018; Ertmer, 2005; Smart, 2016) and, intertwined with a sound TPACK (which measures also increased significantly for these participants), could concur to determine student-teachers actual decisions to use technology and succeed in doing it (Farjon et al., 2019; Knezek & Christensen, 2016; Voogt et al., 2012; Tondeur et al., 2019).

Said dispositions, both technology and pedagogy related, could be recognized in informing participants' reasoning, showing their great influence on it, already found in the literature (see e.g., Farjon et al., 2019; Smart, 2016; Tondeur et al., 2016a). During their first design task, Italian student-teachers' reasoning was very concerned with considerations about content (in relation to the national curriculum requirements, too), pedagogical strategies, assessment and activities to foster content-based learning. Here could be re-traced the inclination toward a central role of the teacher within a school system aiming at fostering pupils' knowledge and skills (§B- Chp.4.2.4). Such results remind of Heitink and colleagues' (et al., 2016), where the reasoning process to integrate technologies was found rather shallow (Smits et al., 2019) and mostly in relation to pedagogical issues.

Through two design cycles, these participants became more and more attentive to the real characteristics of their pupils and the educational context, focusing on how to make the learning experience meaningful for everyone, and using technologies in the process (§Chp.2.3). These findings remind of what suggested in academia (e.g. see Angeli & Valanides, 2018): through experiences of technology integration like design tasks, (student) teacher gradually develop more informed understanding of ICT value and affordances for specific educational contexts (Koehler & Mishra, 2005b, 2009; Kramarski & Michalsky, 2015; Krauskopf et al., 2015; Tondeur et al., 2019). Once again, the alignment with underpinning learning-centred beliefs emerges, as well as the awareness of the broad educational system in which these student-teachers will be called to operate, for example in relation to mainstream education for special need pupils. They also expressed the need to consider ICT as an integrated and connected factor within the reasoning process for design, in the attempt to close the gap between academic awareness and practical realization (see Tondeur et al., 2012). This reflected the course's mission statement, which wanted to set ICT as a variable within teaching methods and didactic considerations (§B-Chp.2.4.3). Moreover, half of the interviewed participants reported an overall net-like reasoning process, in a more mature consideration of the intertwined and situated relationship among all the components of the reasoning process for technology-integrated design (see also Koehler, Mishra & Yahya, 2007).

Our main research question wanted to see the possible link between these reasoning processes, informed by underpinning dispositions, and the very design tasks student-teachers were required to perform. What was the role of the Italian design task procedures and experiences, in sparking the kind of reasoning detected?

In the participants' words was recognizable the double focus of the two design cycles, when they used the academic lexis to talk about teaching methods and approaches, first, and ICT uses, then. This reflects the task's theoretical background (Harris & Hofer, 2009) and its ideal purposes of making student-teachers start from content, learning goals, and pedagogy before selecting the appropriate technological fit, so to have pedagogical, learning-oriented decisions instead of technocentric ones (Harris & Hofer, 2009; Koehler & Mishra, 2005b).

Designing a technology integrated learning unit (and with the specific given guidelines) was a new experience for every interviewed student-teacher, perceived too difficult by just a very few. Although everyone claimed to have used the mandatory guidelines in performing their design, at first not many would recognize a connection between what they reasoned about, and what they were required to perform. To the contrary, many would clearly deny any link between the two on some issues. It is to say that, at first, nine participants thought the task guidelines were unclear and 6 of them were not satisfied with the support received in understanding them. In the second design cycle, student-teachers were more familiar with the task and only a few found it unclear although ICT integration proved tricky to many. While they grew more confident in their skills, aware of educational technologies, and appreciative of their university support, the given guidelines were recognized as more relevant in shaping their design reasoning on several dimensions (§Chp.2.3). Nevertheless, rare was the perfect match between task prompts and reasoning instances, in the words of Italian student-teachers. The design task procedure was found most significant in triggering considerations about context exploration, goals definitions and technologies (*enabling connections/transformation* reasoning dimension). Even concerns about teacher role and approach were positively linked to the design experience, but perceived as artificially described, whereas no meaningful connection was traced on issues like how to transform subject matter, non-technological materials, and classroom activities' definition beyond pupils' previous knowledge engagement and final assessment (*teaching and learning* reasoning dimension).

All in all, Italian design task and guidelines seem to have had some impact on student-teachers' overall dispositions, making them more aware of the role and impact of ICT in education, despite possible concerns, possibly enabling positive attitudes and intentions to integrate (e.g. Farjon et al., 2019; Kim, 2016; Knezek & Christensen, 2016; Voogt et al., 2012). While the direct relation to instances of reasoning was not so widely recognized, task guidelines gained importance in participants' words through time, so much so that five of them deemed their structure highly worthy to be used in their future profession. The observed task and procedure seem a good prompt for reasoning as far as sensitivity to context and goals' definition go, with an interesting outcome on ICT role conceptualization (*enabling connections/transformation*). On the other hand, it seems to have some weaknesses on the definition of classroom-based activities for knowledge building (*teaching and learning*), although the shift in pedagogical beliefs towards a more learning-centred instruction would suggest a possible positive future outcome.

Finally, the mandatory stance of the guidelines' use could have played a role in triggering a cognitive conflict in student-teachers, many of whom expressed their reasoning in the same conceptualization and lexis they were required to work with, and showed instances of new insights genuinely grounded in the design task and guidelines. Reasoning dimensions of *reflection* and *new comprehension* could be influenced also by the fact that these design products were indeed not experienced with a real classroom and pose as an interesting focus for further research.

CHAPTER 3.
DUTCH CASE STUDY

3.1 SUB-QUESTION 1: TPCK INFORMED INSTRUCTIONAL DESIGN PROCEDURE AND PR REFERENCES

The first sub-question in the present study explored the TPCK-informed design procedures implemented in pre-service academic contexts, their bounds to ICT integration models (§A-Chp.3.1) and to PR frameworks (§A-Chp.3.2). The answer to this question was detected in the data collected through documentation (§B-Chp.3.1), participant observation (§B-Chp.3.2) and focused interviews (§B-Chp.3.3). In the Dutch case study, the documents made available to the researcher included: course organization institutional summary (see §B-Chp.4.3.3); course lessons' PowerPoint presentations and online study materials; task instructions and procedure; and task evaluation rubric. Most documents were available in the native language[82], a few in English, and they were the same documents shared with the students during classes. Access to the University course's platform was also granted to the researcher.

As for the participant observation, the researcher spent 6 months in The Netherlands (January – June 2018) and attended each lecture session of the *Learning and ICT* course (§B-Chp.4.3.3) addressed to primary and lower-secondary student-teachers together, for a total of 140h on the field. During this time, the researcher assumed a non-interventionist approach, albeit physically participating to the academic events (Adler & Adler, 1994; Cohen et al., 2007). Either from a corner seat in the audience, or wandering through students' groups, she took notes through the protocols described in Section B (§B-Chp.3.2) focusing on teaching strategies and learners' responses.

While for the portrayal of the course the reader should refer to §B-Chp.4.3.3, the text will now proceed with the characterization of the Dutch task instructions and design procedure, emerged from documentary and observation data collected.

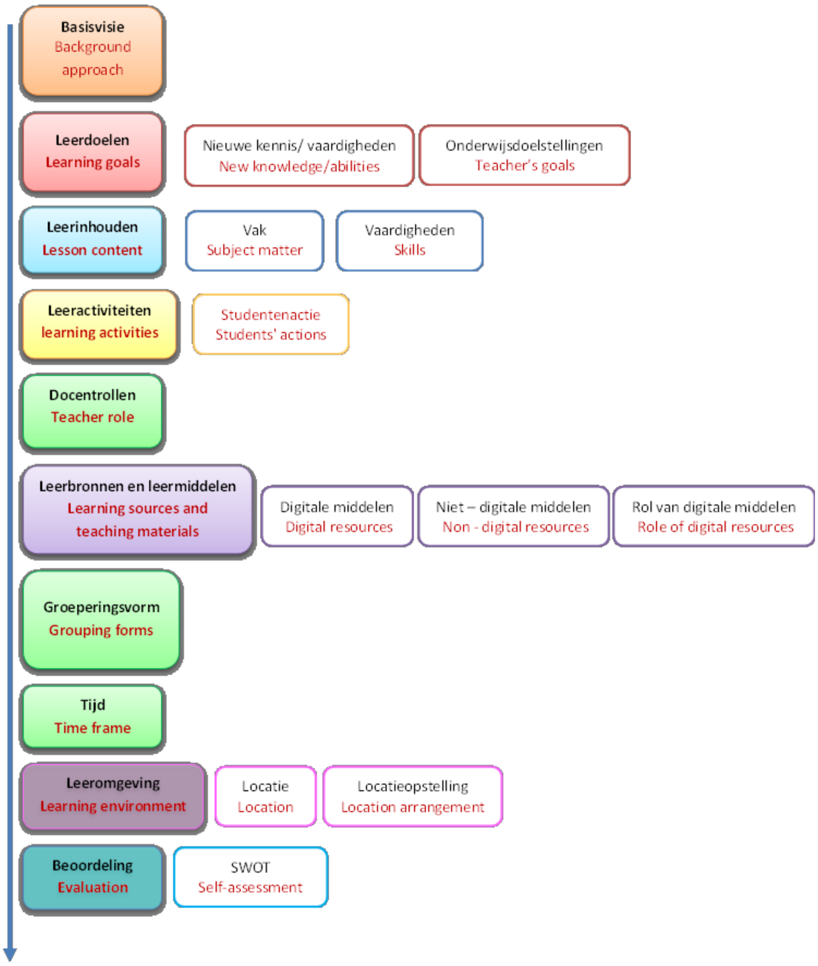
Finally, interviews gave some insight on how student-teachers perceived the given instructions and overall design task[83]. Thus, the relevant findings will be presented to give a thicker description of the design task in place in this case study (Cohen et al., 2007).

[82] As per §B-Chp.3.1, these documents were translated into English by a native-speaker researcher and then approved by their author in the translation.

[83] For the specific codes and prompt questions considered, please see Section introduction and § Appendix 2.1.

Dutch student-teachers were engaged in two cycles of instructional design for a technology-enhanced learning unit. Their first task required individual work, while the second task was completed in groups, but neither was accompanied by mandatory guidelines. Instructions for the first design task stressed the importance of referring design decisions to theories like ADDIE (van den Akker & Thijs, 2009), TPACK (Mishra & Koehler, 2006), SAMR (Puentedura, 2006) and meaningful learning (Howland, Jonassen & Marra, 2012)[84]. In the second design task, student teachers were provided with a real-life context description where to set their instructional design plan, with reference to the school location, size and infrastructure; the number of pupils involved and their school grade; main discipline. Students were given this information beforehand and could actually interact with the specific schools during the design process[85].

The design task procedure they were suggested to follow is represented in Picture 3.1 (in its English translation[86]) and included the following elements[87]:



Picture 3.1 Dutch instructional design procedure.

1. **Background approach →** description of the teacher approach to the learning unit, in terms of adopted learning theory/ies and broad "vision for the lesson" (Stormbroek, 2018). A vision of learning for long term competences was recommended. The main theoretical references required would gather here.

[84] The attention to literature and academic research in this design task reflects the University's mission of educating "teachers as researchers" and not mere practitioners (§B-Chp.4.3.3).
[85] Students were also encouraged to carry out the learning unit designed in the assigned school. As much as this particular and its consequences could give important insights in student-teachers' reasoning, when facing real-life conditions, it was not further investigated in the present study.
[86] English translation was provided by a native speaker researcher (§Chp.3.1) and accepted by the course's Professor as adequate. Picture 3. presents the original items' order but for the original document please see §Appendix 1.3b.
[87] The information hereafter reported has its main reference in Stormbroek (2018), in Appendix §1.3b.

2. **Learning goals** → identification of educational goals, to be declined new knowledge and abilities; and teacher goals.

   2.1. **New knowledge/abilities** → description of soft skills and content-based new knowledge to be achieved by the pupils[88] at the end of the learning unit. It was recommended to identify them in concrete terms, easy to be assessed.

   2.2. **Teacher's goals** → description of teaching/pedagogical goals the teacher wanted to achieve by the end of the learning unit. It was recommended to identify them in concrete terms, easy to be assessed.

3. **Lesson content** → brief summary of concepts to be taught and inner relationships among them. Students were required to specify if the topic chosen for the unit was content-/ professionalizing-/ otherwise- related.

   3.1. **Subject matter** → description of the topic in terms of specific content-related concepts to address;

   3.2. **Skills** → description of the topic in terms of specific soft skills implied.

4. **Learning activities** → description of the lesson(s), for each of whom to specify which activities would take place and the pupils' role in them.

   4.1. **Students' actions** → description of pupils' visible behaviour and actions to be carried out during the activities.

5. **Teacher role** → description of teacher's (or other implied educators') visible behaviour and actions to be carried out during the activities.

6. **Learning sources and teaching materials** → description of foreseen materials and resources to be implemented during the activities. They were to be declined in technological and non-technological, with a clear expression of the added value of the former ones.

   6.1. Digital resources → identification of foreseen ICT use in the planned activities, with mention of their affordances and characteristics.

   6.2. Non-digital resources → identification of foreseen non-ICT resources' use in the planned activities, with mention of their affordances and characteristics.

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[88] Pupil is referred to primary or lower secondary students whom the instructional design product was addressed to.

6.3. **Role of digital resources** → description of the chosen ICT's added value for the specific activity. No further suggestion or requirement was provided as to link the added value to either content or pedagogical choices.

7. **Grouping forms** → description of foreseen grouping forms, during the activities. Students were required to describe the composition process and characterization of grouping choices.

8. **Timeframe** → identification of duration of the learning unit. Students were also asked to specify the timeframe expected for the single activities.

9. **Learning environment** → description of the context in which to set the learning unit. The contextual characteristics were to be declined in terms of spatial organization of the learning unit activities, but no further depiction was required about the pupils' characteristics.

9.1. **Location** → description of the physical location where the learning unit would take place (e.g. inside or outside the school);

9.2. **Location arrangement** → description of the specific arrangements and modifications to the broad location, related to the specific activities.

10. **Evaluation** → assessment carried out in different forms, even with technology. No explicit mention/requirement about feedback.

10.1 **Self-assessment SWOT** → teacher's self-assessment carried out in different forms, even with technology.

As a further note, students were required to reflect on their own process of planning a learning unit through prompts like: "*my preliminary idea on this"; "who/what do I need for this?"; "which actions should I undertake to complete this?*". These prompts were transversal to the IDP items (Stormbroek, 2018) and seem to suggest a self-regulated learning approach to the whole task (Kramarski & Michalski, 2015).

The design task product was evaluated as presented in Table 3.1 (also reported in its English translation[89]). Each design product added up to 20% of the final students' evaluation for this university course.

[89] English translation was provided by a native speaker researcher (§B-Chp.3.1) and accepted by the course's Professor as adequate. Table 3.1 reports the original order of the rubric's components, but for the original document please see §Appendix 1.3c.

Table 3.1 Design product evaluation criteria – NL.

Criterion	Indicator	Points
1. Learning objectives	Good: clearly formulated on the basis of Bloom's taxonomy. There is coherence between actions and learning objectives as well as accountability for them. The chosen assessment form is well-founded and justified by relevant sources	5
	Sufficient: Clear learning objectives have been formulated and the chosen assessment form is suitable for them	3
	Insufficient: The learning objectives are not clearly formulated and/or the assessment does not fit in with them	1
1. 21st century skills 2. TPACK 3. Meaningful Learning	Good: The sources used are relevant for substantiation and strengthen the choice of model, in relation to enhancing the learning experience	5
	Sufficient: Two characteristics from the model are described in relation to the added value for the learning experience. A source has been used for each characteristic.	3
	Insufficient: The theory referred to is not correctly linked to good practice.	1
4. Instructional actions	Good: instruction is written clearly and professionally. The working method -especially how and why- becomes clear and is well structured. The instruction can be used well by a fellow teacher.	5
	Sufficient: instruction gives an explanation of the working method and it becomes clear which supporting materials are to be used.	3
	Insufficient: instruction does not give a clear and/or complete picture of the lesson	1
5. SWOT	Good: The SWOT analysis is clearly described and well substantiated with the help of relevant sources	5
	Sufficient: SWOT analysis is clear and concise and corresponds to the good practice presented	3
	Insufficient: incomplete SWOT analysis	1
6. Theoretical references	Good: relevant and wide literature provided, according to APA style	5
	Sufficient: relevant literature provided, not according to APA style.	3
	Insufficient: no literature available	1

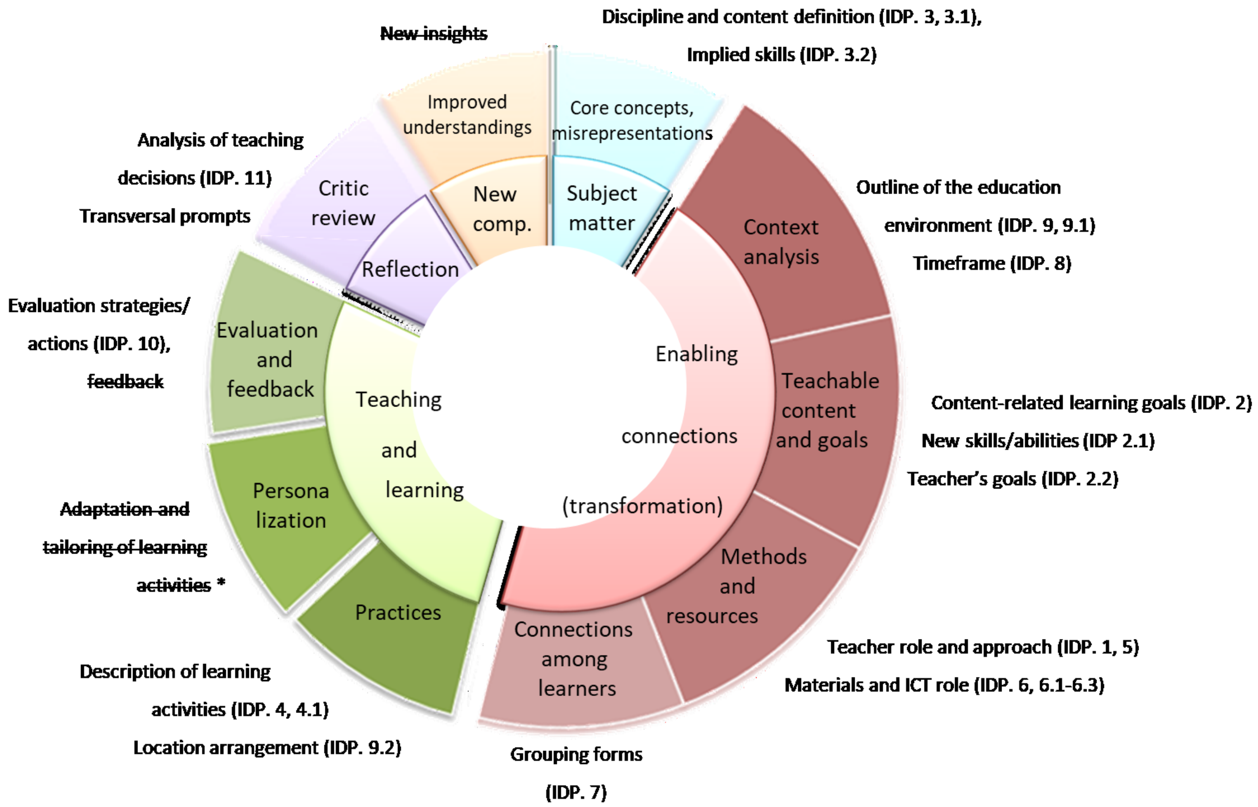
Detecting the theoretical foundations of the Dutch design task procedure in relation to technology integration was facilitated by the multiple references in the instructions and evaluation rubric.

Manifold were the theoretical pillars for this procedure, from TPACK to SAMR to Meaningful learning with technology. The *Technology Pedagogy Content Knowledge* framework (Mishra & Koehler, 2006) was adopted without further implication about a transformative or integrative perspective (Graham, 2011). Evidence of this can be found in the evaluation rubric for the design products (Table 3.1), and in the course professor's explanation of the tasks. The TPACK base for technology-integrated design was accompanied by references to the *Substitution, Augmentation, Modification and Redefinition* model (SAMR – Puentedura, 2006 - §A-Chp.3.1.1). This is meant to facilitate optimal learning experiences using technologies (Romrell, Kidder &

Wood, 2014) while also promoting 21st century skills (Hilton, 2016; Cummings, 2014). SAMR presents a four-level taxonomy for selecting, using and assessing technology integration (Hamilton, Roseberg & Akcaoglu, 2016): *Substitution* and *Augmentation* are enhancing means to the existing tools in the learning tasks, while *Modification* and *Redefinition* actively transform the learning opportunities available (Hilton, 2016). SAMR figures as a powerful and popular framework to redesign traditional lessons using technology to enable otherwise-impossible learning processes (Hilton, 2016; Romrell, Kidder & Wood, 2014). Nevertheless, some authors highlight the need for a stronger theoretical explanation of the model, especially in peer-reviewed literature (Hamilton, Roseberg & Akcaoglu, 2016), so to minimize very different interpretations of the SAMR and its practical realization.

Finally, the procedure seems to allude to the *Meaningful Learning* approach (Howland, Jonassen & Marra, 2011) to integrate technology. This perspective encourages to select and adopt technologies with the primary aim of realizing meaningful tasks for the pupils. In such model are listed five characteristics of learning that technology use must recognize and support: (a) *manipulative*: learners need to be actively engaged in the task, observing and manipulating objects at study; (b) *constructive*: pupils need to articulate their understanding of the learning experiences, reflecting on the possible discrepancies between what they understood and what they could observe; (c) *intentional*: pupils need to address problems they really want to solve, planning and executing ways to make it possible; (d) *authentic*: learning experiences need to be situated, embedded in real life; and (e) *cooperative*: learners need to socialize their knowledge, negotiating meanings. Once again, evidence for the connection among the Dutch procedure and this model for technology integration are to be found in the evaluation rubric for the design products and in the oral instructions provided by the course professor to the student-teachers.

Along with said theoretical ground for technology integration informing the task, any reference to reasoning models was sought, as for the research inquiry at stake. Considering the adapted PR model described in §B- Chp.3.1 as lens for data analysis, it was sought to identify any overlap with the Dutch design task procedure's items (Picture 3.2).



Picture 3.2 PR model in design task procedure - NL.

The items' attribution to the different PR dimensions was made according to the formers' definition within the instructions given to the student-teachers. Additionally, the transversal prompts embedded in the procedure were included and attributed to the *Reflection* dimension, as they implied a metacognitive approach to the design practice.

Personalization reasoning dimension was not directly detectable in a specific item, but was indeed suggested by the instructors explaining how to complete the design task, while the underpinning meaningful learning perspective would have possibly pressured towards the tailoring of the learning experience. Nevertheless, as is was not explicitly required by the procedure items or its evaluation rubric, but pertaining a more subjective interpretation of the task, caution should be used in attributing them to reasoning dimensions.

Finally, *feedback practices,* and *new comprehension* were apparently neglected by the Dutch design procedure. While the first one was not explicitly addressed even in other materials or course lessons (to the researcher's knowledge), the latter was somehow detectable in the course professor's evaluations of design products. Formative evaluation was given by the professor during lecture course sessions[90], possibly sparking informal discussions among student-teachers. Given these blurry conditions, it could not be set a clear and solid connection between the design task procedure and the *new comprehension* reasoning dimension on the student-teachers' side.

[90] It is to highlight that while course attendance was compulsory (see §B- Chp.4.1.3), it is no guarantee of equal participation and interest by every attendant.

To better answer the research question on procedures' connection to pedagogical reasoning for technology integration, how such tasks and procedures were understood by student-teachers was also investigated. During focused interviews (N= 26[91]), participants mentioned instances about:

- *Familiarity of the procedure*, useful to investigate possible previous experiences with a technology-enhanced design that might influence this task's performance.

  Eight student-teachers (first design cycle) said that the given procedure was significantly different from any other previously used at university, expressing different reactions to this novelty: "[usually you need to design] a single lesson, you must do […] little assignment, now you must think about more [lessons connected], so the start, the middle, and the end" (NL1a[92]); "you get a whole lot of creative freedom, they kind of force you to read the literature, but it's not just questions and multiple choice so you really […] connect it to the practical part of doing it, it really sticks" (NL8a); "the exercise [i.e. designing a learning unit] I have done it before, not in this particular fashion, but I've done them" (NL12a). Interestingly, the procedure was still completely new to seven interviewees even after the second design cycle: "to be honest it's the first time I see them [i.e. the instructions]" (NL13b). This anticipates the issue of relevance of the guidelines, described below.

- *Relevance of the procedure,* analysed to understand if the student-teacher actually used the given guidelines in performing the task or relied on other resources. Eight and seven interviewees, respectively after the first and second design cycles, said to have not followed the suggested procedure, preferring to use pre-made materials: "I had like 2 lessons, I planned last year […] using a WebQuest and…to save myself a lot of time, I didn't really want to like design 2 whole new lessons, so I used those 2" (NL2a); "I used [what I handed in] already with another [course's] assignment" (NL4a). Some would rely on their personal experience: "I have a system for [planning a lesson]: we have introduction, we have like a video or something, or conversation, then we go to like the content of the lesson and then we do this and that and…[…] I am not really seeing I'm going to change that yet" (NL2b); "I always have kind of a standard order in how I do things: so first kind of an instruction then talking with the children, then they do their task and then you evaluate with them and like 'what did you learn' and that kind of stuff" (NL11b).

[91] As the reader might recall (§B-Chp.3.3, B-Chp.4), interviewees were 13 after the first design cycle and 13 after the second.

[92] Due to privacy reasons, participants' names will be masked at all times. They will be referred through the belonging case's acronym (CY, IT, NL), a number, and the letter "a" if it was the first interview (after the first design cycle) or "b" if it was the second interview (after the second design cycle).

The *performance orientation* of the student-teachers interviewed was also fairly high, with instances in seven first-cycle interviews and four second-cycle ones: "[I figured] I'll just write something down now and see if I get like a 6 [i.e. minimum grade to pass] or something […] because it was a lot, to do everything in detail" (NL2a); "I think I did it the way they wanted me to, or did it in a way that it made sense to them. So, I think it went well" (NL3a); "it's a waste of time, you have [to do just what they ask you], you might learn something more about a certain skill [i.e. 21st century skills], but because it's only an assignment, you waste your time [if you delve deeper]" (NL6a); "I could have just read just 2 parts of the really 15 articles that were out there and just make the assignment. I could have, but I […] scammed through most of them and […] [in that sense] I expected more of a test: that it [would be] more of a test to check, to see if I understood what I've been taught in the last few weeks" (NL12a); "I still find it a little bit too broad, too open, it used to come down a little bit more to the things they want to hear [in the other courses] […], I would recommend them [to] make it a little bit less open" (NL13a); "in the end it came really [to] what she [i.e. teacher] wanted, so she's happy so it was [a] good [assignment]" (NL4b).

- *Understanding of guidelines*, considered to identify the main perceived difficulties in comprehending and performing the design task. Guidelines were perceived as problematic for eight and five interviewees respectively after the first and second design cycle, for different reasons. Some would report difficulties in understanding the task requirements, for example: "I didn't know what to expect because they said 'assignment' but when I heard 'assignment' I think question-answer, question-answer […] but it was totally [an] other kind of assignment so I think maybe they can say […] maybe little tips or what they expect" (NL1a); "I found the exam to be very open, so it was maybe a bit hard to see what was necessary to, well, to be able to finish it with a good grade" (NL3a). Others would not understand (or seemingly access altogether) the materials: "like a rubric, that was totally missing in this exam. So, they didn't say like 'ok TPACK is worth like 40 points', and 'SAMR is worth 20 points', so that made it kind of difficult to like make a decent exam" (NL2a); "I found the exam to be very open, so it was maybe a bit hard to see what was necessary to be able to eh finish it eh with a good grade because it was very broad […] we didn't have a benchmark to compare the test to, so that was a bit hard" (NL3a). In the second design cycle the main difficulties were related to understanding the demands emerging from the school context: "when I got the assignment, it still wasn't really clear what we had to do, and when we went to the school, it still wasn't clear what we needed to do" (NL8b); "the difficult thing was because we were given a strict area where we could work because it was all 'you have to do this [i.e. subject matter] and your students have to do this [i.e. learning goals], and this shouldn't be possible, and it should be easy' and so" (NL12b).

Another important difficulty, mentioned by eleven student-teachers (albeit just in the first interview[93]) was the requirement to embed theories in the design: "I think the most difficult part for me is to actually use the literature, like actually put that in […] because most of the time I think I know this already so why should I put it down that I read it there?" (NL11a); "for me this was the first time to design a learning plan more or less, with the theories around it, so that needed a different state of mind I guess, to be able to do this assignment" (NL3a); "normally you can just say what you do and why you do it, now you have to say why you do it and you have to connect some theory to it, so that was a bit difficult" (NL4a); "when I choose something to use it in one of my classes I can't specifically identify immediately what kind of 21st century skills are connected to it, because I read them all through and like it might be [this one] but it might also be that one, I don't know if it can be both, like that kind of stuff so I get a bit stuck in my head on certain things on that kind of theory" (NL6a).

When facing difficulties, in either design cycle, participants asked for help mainly to their fellow student-teachers (e.g. "we like have a WhatsApp group and if we have a question we always go to each other" - NL2a), or used internet as a repository ("I have to look up in the internet so what do they really mean" - NL12b).

- *Technology integration requirements*, investigated to see how this issue was perceived by the student-teachers in relation to the procedure's conditions. Integrating technologies in the design was not reported as highly problematic by any interviewee: just a few (2 in the first round and none in the second) expressed mild concern in having to consider the issue: "of course there were some new things that were a bit more difficult to work with, especially since they're really into the ICT technology part, so when my mind set here is like 'we have to use as much as possible', but not too much of course, […] you have to find your own way through [the assignment] while using the technology" (NL11a).
- *Overall worth of the given procedure* as effective guidelines for designing a technology-integrated learning unit. Just a few interviewees (two after the first design cycle, one after the second) mentioned they would consider these instructions valid, mentioning: "now I can use it for my own, so I think it will help me model [my lessons]" (NL1a); "I think more for technology, but when I do something with technology [and I feel like] it's wrong, in my mind […] maybe I will think about it [i.e. the procedure], maybe the lesson will be great or more better" (NL1b). After the second design cycle three student-teachers would discard the procedure completely (e.g. "I don't think I'm going to use ADDIE or TPACK or something, because when I

[93] The reader should be reminded of the different importance attributed in the two design cycles to either the theoretical references to practice (first cycle) or the real-life context (second cycle), which could help ponder the interviewees' answers.

think when I'm a teacher I don't have time for it" -NL10b; or "I find it too complicated to use it" - NL13b), and five would attribute it just limited worth (e.g. "I think it could be useful if you're not that experienced in doing stuff but after a while it becomes more automatic I think" - NL8b; "I think [it depends on what you] have to do, [it has] to be a big project, then maybe it's possible but otherwise it would take a lot of time" - NL4b).

These findings are relevant to the first research sub-question (§B- Chp.1) as they help understanding intended and perceived connections between the implemented design procedure and the theoretical models for pedagogical reasoning for technology integration. Moreover, this information helps in answering the main research question because it sets a situated background of references to interpret data on reasoning manifestations (§Chp.3.3). From the above reported findings, the given design procedure seems to have had clear and multiple theoretical foundations for technology integration, transparent even to the student-teachers, who would use the same lexis to refer to the assignments (e.g. "TPACK", "ADDIE" mentions). Notwithstanding a general tendency to performance orientation and the perception of novelty in the given procedure, most of the interviewees did not use the given procedure to complete the design tasks. This is particularly relevant because it would make us cautious in interpreting the mentioned difficulties in using the procedure or the perception of worth attributed to it, although it cannot be stated any causal relation among the issues. These premises, and the overlap found between the procedure's items and most of the PR model dimensions, will pose as a ground of interpretation for actual participants' reasoning manifestations and their relation to the contextual procedure (§Chp.1.3).

3.2 Sub-question 2: Student teachers' dispositions toward ICT integration

The second sub-question leading this research regarded student-teachers' dispositions towards technology integration (§B- Chp.1). These were observed twice: when participants were just starting to deal with the issue (i.e. at the beginning of their university course and at their first concrete attempt to design with technologies) and once they had multiple experiences on it (i.e. at the end of their course and after yet another technology-integrated design cycle). In this mixed method section embedded in the wider research (Creswell, 2013) the implemented instruments for data collection were a pre-/post- questionnaire (§B- Chp.3.4) and focused interviews (§B- Chp.3.3). Data were collected independently in the six-month time span spent in the Dutch context, then merged when interpreting the results (parallel convergent mixed method – Creswell, 2013).

In the next paragraphs the Dutch findings will be described, as emerging from the quantitative and qualitative instruments according to the specific research question. Participants' dispositions towards ICT integration will be portrayed as shown first at the beginning of their academic journey on this issue, considering the overall population and a typical student-teacher. Then, it will be inspected how these dispositions changed after multiple experiences with TPCK-informed design tasks, for the Dutch student-teachers.

AT THE BEGINNING OF THE ACADEMIC JOURNEY FOR TECHNOLOGY INTEGRATION

Considering the pre-questionnaire data (N=11), at the beginning of their university course Dutch student-teachers appeared overall very open to the possibility of integrating ICTs in educational practices[94]. As per Figure 3.1, participants expressed very high measures of comfort and ease in using technologies (*enablers* Mo= 4.6, range=1.4), accompanied by extremely low measures of stress and avoidance (*barriers* Mo= 1.1, range=1.0).

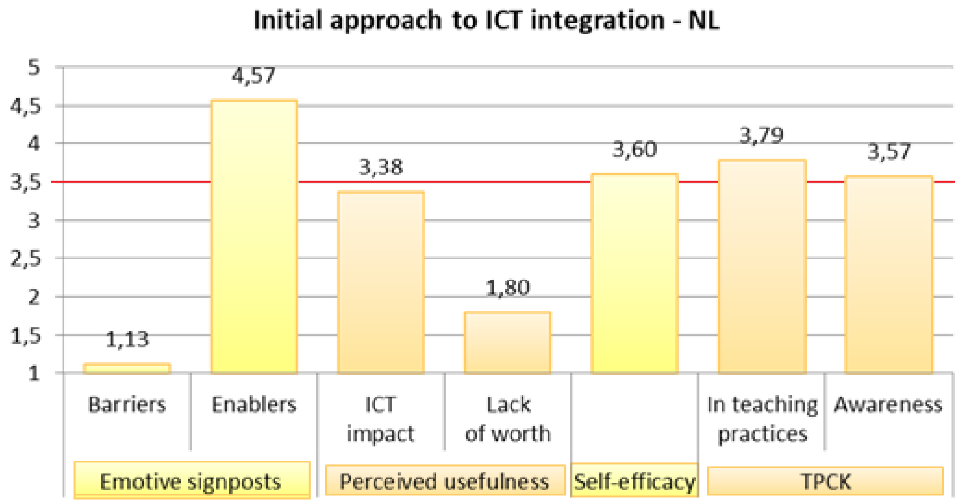


Figure 3.1 Pre-questionnaire measures for dispositions towards ICT integration - NL (Mode, N=11).

Briefly anticipating the qualitative findings, a couple of interviewees' quotes on this point: "I love tech, I love playing with that stuff" (NL3a); "I'm not a person that have difficulties with ICT tools, it's very easy for me so this is ok" (NL10a). On the other hand, some of the less positive would say things like "I'm not really [the] type to just grab a robot and find out how it works" (NL11a); "technology grows everywhere and I can't make it stop or anything, they [i.e. pupils] only see the computer as teacher and the real teacher sitting down

[94] In order to better represent the characteristics of this small numbered group of participants, data will be presented in using Mode values (Mo) and range rather than means and standard deviation.

and waiting […] when it takes all our chances [as teachers] I don't think I want to be a teacher anymore" (NL1a); "most of the things in primary education are really going to get away because of ICT [and this scares me]" (NL9a).

Dutch student-teachers would also perceive some potentialities in the use of ICT for teaching and learning, as in the slightly above average score reported on *impact* (Mo= 3.4, range=1.1) and the mildly low one on its ideal opposite: *lack of worth* (Mo= 1.8, range=1.2). Again, some example from the interviewees' words help understanding that such worth and lack thereof have different meanings: "they tell me that when you see something that comes better in your head than when you read it, so with movies and with pictures, and stories, the internet tools they can see it visualization" (NL1a); "so the added value of videos is to explain, I can explain it myself, but the video can do it [in a] shorter [time]" (NL2a); "[technology enables pupils to] find different ways to express themselves and I think that that's pretty important and often missed, in especially in history because these things can really help children to visualize a concept" (NL3a); "I think it can have ah a big added value" (NL8a); or on the other hand "I think it's very important that we can still talk, instead of only working on a computer or at a cell phone" (NL11a); "the teacher cannot see what they do on the computer" (NL6a).

Their *self-assessed capability* in selecting, integrating and assessing the use of ICT in education, at the beginning of the university course scored mildly high (Mo= 3.6, range=1.4), suggesting a good level of confidence. When it comes to the interviewees' words, many could be found supporting a high self-confidence: "[about] my lesson itself I'm very proud of" (NL5a); "I think it would be really valuable for me to eh learn how to convince my colleagues, how to instruct them [about] how they can properly use technology in their lessons […] show them the light" (NL8a); and a few more self-doubtful, for example "I was thinking very hard about the thing [i.e. how to embed technology], and I don't know, and I don't know, and I still don't know" (NL1a.)

Finally, Dutch student-teachers' perception of their own TPCK at the beginning of the course scored mildly positive, both in relation to the *awareness* of possible content-pedagogical technologies (Mo= 3.6, range=1.4) and to their actual *practical integration* (Mo= 3.8, range=2.1). As the interviewees would say: "you have to have a goal and then see what ICT can add to it, what's ICT doing with us that we can get our goal, first think about goal not ICT" (NL5a); "I think ICT can be very interactive and like different approach to my lessons, that keeps it interesting for the students, so I really want to proceed in the learning about it, definitely" (NL2a).

Going a little deeper with the quantitative data analysis, some patterns could be identified in student-teachers' answers to the pre-questionnaire and thus detect several profiles. The one most grounded in the Dutch context, i.e. who gathered the most respondents: 6 out of 11 (55%), was Daan[95] (see Table 3.2 and Figure 3.2).

Daan is likely a 17-22 years old student-teacher, with a positive appreciation of *university equipment* and *encouraging actions* (mean scores on these areas[96] are 3,5-3,8 out of 5 in the Likert scale). He is fairly familiar with *lower order digital applications and software* ($\bar{x}$ =3.6), but not so much with the *higher order* ones more specialized for the educational context ($\bar{x}$= 1.9). He is also very keen on *surfing the internet* to explore web-based technologies ($\bar{x}$=4.8).

His dispositions towards ICT integration are interestingly positive, with scores on the higher end of the scale on most indicators (see Figure 3.2). At the beginning of his academic journey on technology integration, Daan's rates of ease (*enablers*) and *perception of worth* in using technologies for educational purposes are quite encouraging (both $\bar{x}$ =4.2, see Table 3.2). He appears to be rather *aware* of the ideal possibilities for technology integration (*TPCK awareness:* $\bar{x}$ =4.0), and *self-confident* ($\bar{x}$=4.1) also about his capabilities, even in relation to in actually performing *technology-integrated practices* (*TPCK in practice:* $\bar{x}$ =3.9).

Table 3.2 – Daan's profile in relation to other student-teachers' profiles – NL.

Factor	Mean	Sig.*	Cohen's *d**
Emotive barriers (stress and avoidance)	1.54	.000	≥.65
Emotive enablers (comfort and openness to use)	4.20	.000	≥.96
Impact of ICTs on teaching and learning	4.23	≤.001	≥.51
Lack of worth of ICTs in education	1.71	.000	≥1.4
Self-efficacy	4.14	≤.001	≥.76
TPCK in teaching practices	3.87	.000	≥1.03
TPCK awareness	3.99	.000	≥1.49

* These measures refer to the statistical significance and size effect of this profile's distance from others. As there were overall four different profiles, if manifold, the bigger (for significance) and smaller (for Cohen's d) values are displayed.

[95] This is a fictional name and any resemblance to real events and/or real persons is purely coincidental.

[96] As the reader might recall from §B- Chp.3.4, the questionnaire's factors related to this topic are: *Surrounding encouragement* (α = .79), *University equipment* (α = .83), and *University's active role* (α = .92). As Daan is a profiled student-teacher virtually representing 73 participants across case studies (see §D - Chp.2), his scores will be described using parametric statistics.

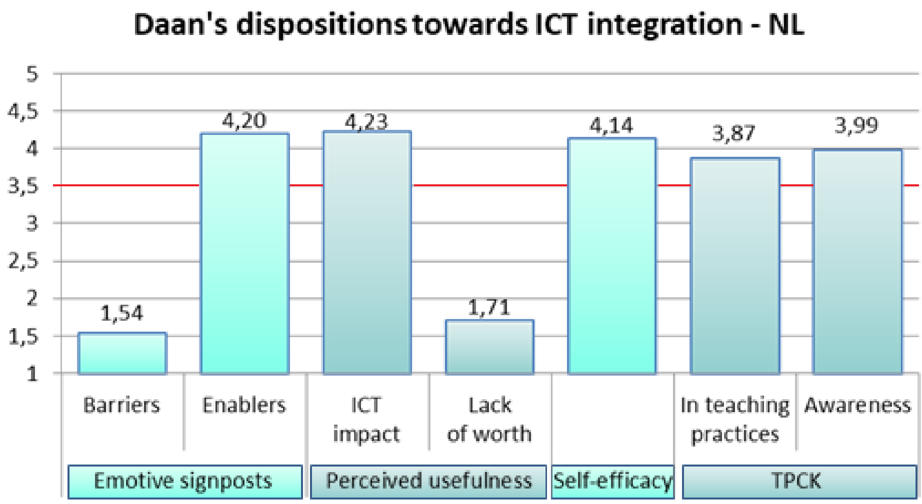


Figure 3.2 Daan's scores for dispositions towards ICT integration (means).

Daan's characteristics, so close to the overall Dutch participants' and yet not exclusive to this case study, will be further analysed in §D – Chp.2 within the cross-case perspective.

Finally, to take the maximum advantage from the mixed method approach to this matter of inquiry, a multidimensional scaling was carried out on the pre-questionnaire data (Figure 3.3), while first-round interviews'[97] codes were mapped through the Epistemic Network Analysis software (ENA – Figure 3.4). They will now be observed them together, focusing on clusters of items and codes, as in both analyses distance indicated difference in the items/codes' roles in shaping the answer/discussion.

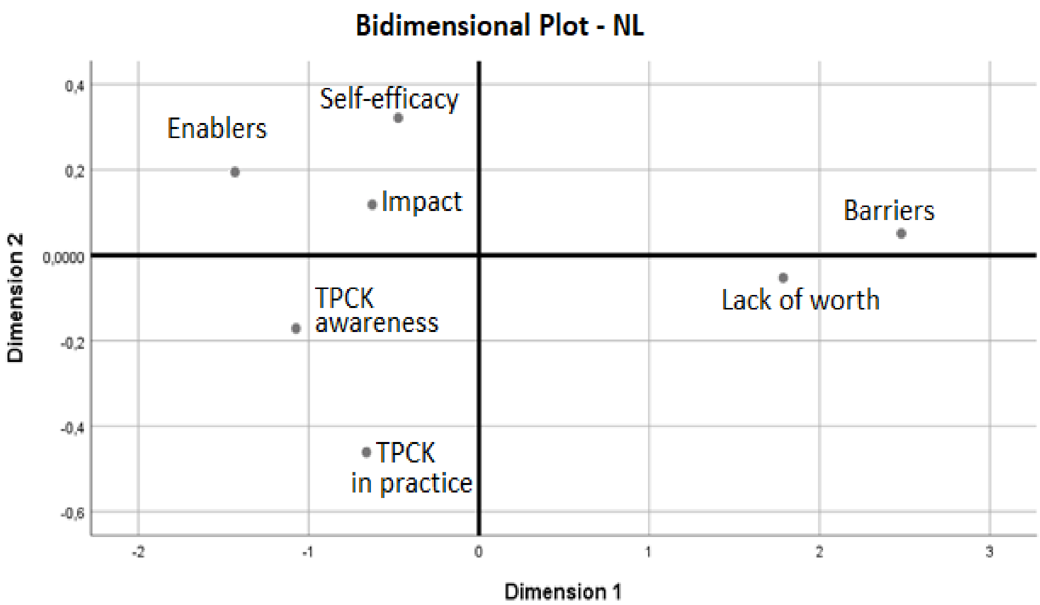


Figure 3.3 Dutch pre-questionnaire respondents' dispositions (multidimensional scaling, N=11).

[97] N=13.

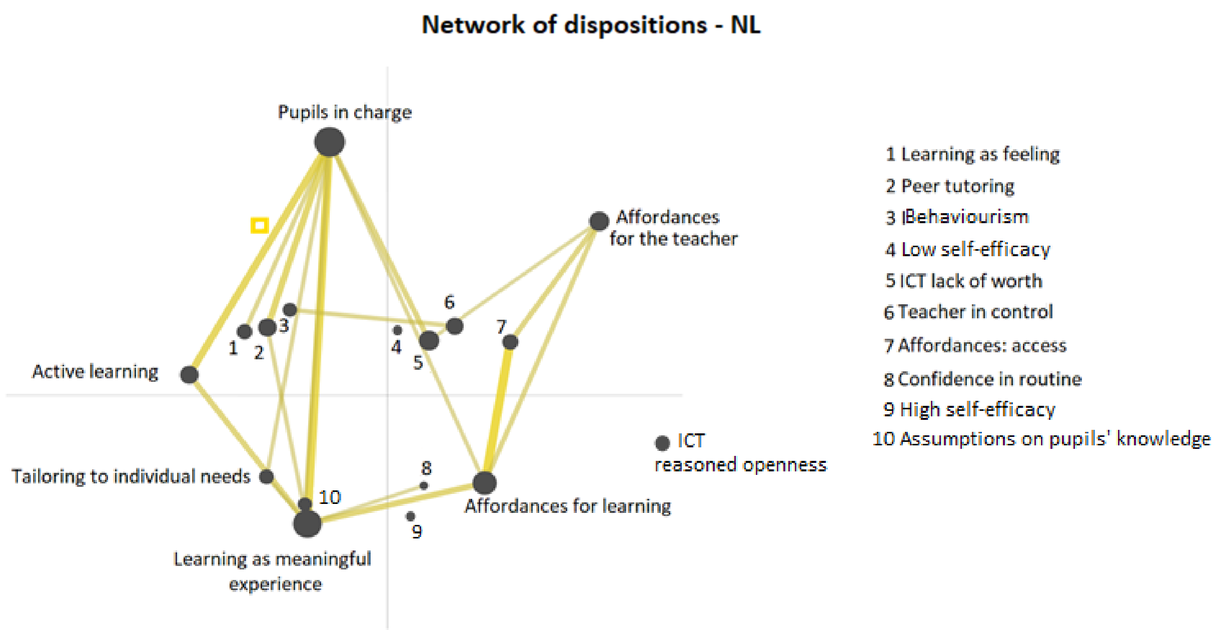


Figure 3.4 Network of dispositions - NL first interviews (connections among codes, N= 13).

It is fairly clear by Figure 3.3 how *emotive barriers* and a perception of *lack of worth* of technologies in education stand on a very different ground from *emotive enablers* and the perception of *impact of technologies* in the learning experience. The same contraposition could be retraced in Figure 3.4, where *ICT lack of worth* (5) figures quite far from *affordances for learning* codes (considered as indicator of technology *impact*).

Furthermore, *self-efficacy* in Figure 3.3 joins closely the positive approach to technologies (namely *ICT enablers* and perception of *impact*) suggesting a possible correlation among the three in the minds of the respondents. In Figure 3.4 instances of *low self-efficacy* (4) appear close to the ones about *ICT lack of worth* (5), whereas on the other hand comments of *high self-efficacy* (9), far from that area of the model, show next to *affordances for learning* and *confidence in routine* (8). This last knot accounts for the interviewees' comments on their confidence about teaching and learning issues as rooted in their own experience as students (e.g. "I'm quite comfortable with making lesson series and everything because everyone tells you [that] you have to do that anyway" – NL11a).

The cluster including *TPCK awareness* and *TPCK in practice* (Figure 3.3), somehow close to the side of the positive dispositions toward ICT integration, could be reflected in *ICT reasoned openness*[98] (Figure 3.4). Although this knot is not directly connected to any other, its position in the figure (hence its role in shaping the model) is on the side of *affordances for learning* and accounts for instances like: "I think ICT eh can be used as help tool for the students, not for the role of the [teacher], so it's to make it easier to find some information, it's not my [idea] to have ICT to take over the role of the [teacher], its part [is] to help students" (NL10a); "sometimes they say 'wouldn't it be nice to have all your books on iPads?' No, it's

[98] This code marked interviewees' comments of willingness and openness to use ICT in education expressing clear reasons linked to specific topics/affordances/teaching approaches/pupils' characteristics.

not! Because like iPad is like this [mimes horizontal line] and the page is like this [mimes vertical line] so [the book does not] fit on the iPad! I want to use technologies but not like for just anything" (NL6a).

Moreover, through the ENA software was possible to explore not only the codes' role in shaping the model, but also their weight (the codes' frequency can be inferred in the size of the dots) and the connections[99]. This way, it seems that the Dutch interviewees would mention contrasting ideas on teacher and pupils' roles. On the one hand comments for a *teacher in control* (6) of the whole learning experience could be found connected to a *behaviourist* (3) perspective and the use of technologies to the advantage of the teacher (*affordances for the teacher*), for example: "it's not like that based on the outcome of the question [on what pupils may know about the subject] I change the lesson. I really like to have a plan" (NL2a); "it has to be me first […] so I can get them [i.e. pupils] my own instruction, I have to instruct them first before I let them play with it [i.e. the topic] and I want to do it by myself, my own instructions [not through technologies or other tools]" (NL7a).

On the other hand, there was high frequency of comments for a central and active role of pupils in education (*pupils in charge* and *active learning*), linked to the strive to create *meaningful learning experiences* and the value attributed to *tailor* practices *to individual needs.* Examples of this area of the network could be "I want to do it [i.e. my lesson], so that they can understand without my help" (NL1a); "[as a teacher] I want to know if there's something wrong or if something happened that was great or not so great because if I see behaviour I really want to relate something instead of just not knowing what's going on and just send them out of my class because maybe there was something that happened, and I could have understand it but if I didn't do the conversation, I wouldn't know that much about my class so I really want to know what's going on with my students and why some behaviour is happening in my class" (NL13).

Finally, the centroid of the discussion (little square in Figure 3.4) would suggest that core of the model of Dutch student-teachers' first round interviews gravitates to the side of *active learning* and *pupils in charge*. This might suggest that the interviewees were really engaged in pedagogical beliefs entailing educational experiences focused on pupils' actions in the learning experience.

AFTER MULTIPLE ACADEMIC EXPERIENCES FOR TECHNOLOGY INTEGRATION

As the reader might recall, the present research was also interested in how student-teachers would describe their dispositions towards ICT integration after multiple experiences with TPCK-informed instructional design and the completion of the germane university course (§B-Chp.1).

[99] It is to highlight that for analysis and visualization purposes, ENA minimum threshold was set at 0.3, showing only the strongest connections among codes, relevant for the whole population of interviewees.

Thus, the findings from the post-questionnaire and the qualitative evidence gathered on the topic after the second design cycle will now be described.

A Wilcoxon test on paired questionnaires (N=10) suggested that Dutch student-teachers did change significantly on three areas, namely *lower order digital applications and software* (T= 39, *p*= .049, *r* = .44, *d*= .98) and *higher order* ones (T= 39, *p*= .046, *r*= .45, *d* = .99); and *TPCK awareness* (T= 51.5, z=2.506, *p*= 0.012, *r*=0.56). Participants' answers were higher in the post-test for both the background measures of technology use: respectively, moving from Mo_{pre}= 2.9 (range 2.5) to Mo_{post} = 3.7 (range 2.25) for *lower order technologies,* and from Mo_{pre}= 1.3 (range 2.4) to Mo_{post} = 1.4 (range 2.3) for *higher order* ones. These are not strictly dispositional factors, but still account for some changes possibly fostered by the academic course and design experiences occurred, which included at least the exposure to several digital educational tools for technology integration.

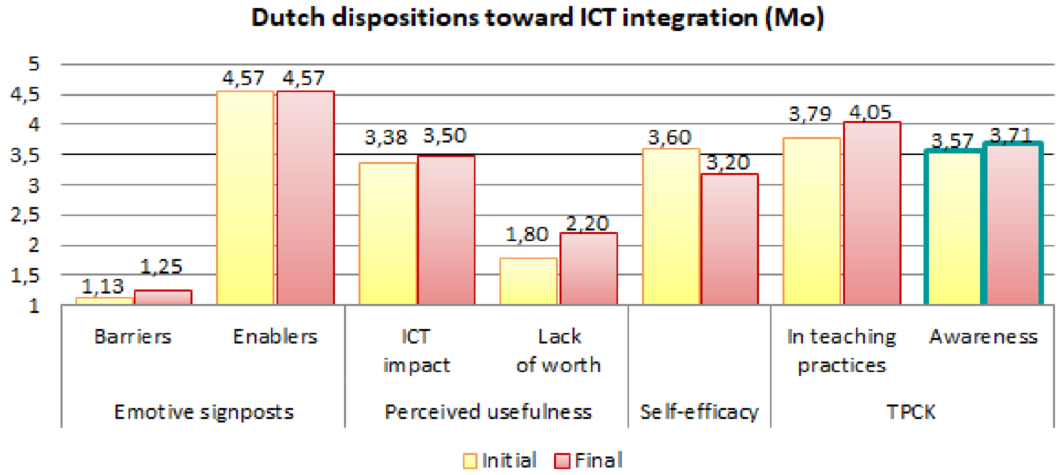


Figure 3.5 Dutch participants' dispositions in the pre and post questionnaires (Modes).

Albeit participants' *TPCK awareness* levels did not seem to increase much (Figure 3.5), from a Mo= 3.6 (range 1.4) to a Mo= 3.7 (range 1.3), such change had a size effect of *d* = 1.3, indicating a largely significant increase in their self-assessed knowledge of possibilities for content, pedagogy and technology interconnections.

None of the background areas related to *access* to technologies and appreciation of *contextual support* saw a relevant modification in Dutch participants' answers to the post-questionnaire[100]. At the end of their university course and after completing multiple TPCK-based design tasks, they remain highly comfortable in the use of technologies (*enablers* Mo= 4.6, range= 1.7), although they seem slightly more critical of the actual *worth* in education (*lack of worth* Mo= 2.2, range= 1.2, versus *impact* Mo= 3.5, range 0.8) and concerned about their use (*barriers* Mo=

[100] For the initial scores on the Dutch *knowledge of ICT use, access* and *contextual support appreciation,* please see §B-Chp.4.3.4.

1.3, range 1). Their *self-efficacy* lightly decreased (Mo=3.2, range= 1.0), but the self-assessed *practical TPCK* proficiency remained on the higher end of the scale (Mo= 4.1, range= 1.0).

Interestingly, from the qualitative data emerges that six Dutch student-teachers after the first design-cycle, and seven after their second one (N=13), would explicitly mention being meaningfully more confident in and open to integrate technologies because of the course and/or experiences with the design task, for example:

- ✓ "I think now I am more knowledgeable on how to use those things yes" (NL3a);
- ✓ "I never heard about it, never like analysed something with TPACK and it really gives [a] spectacle of why do I use this, why would I actually need this, do I need to use this? And it gets you thinking, like I can make the whole lesson digital, but does it add something?" (NL6a).
- ✓ "they actually make me see how satisfying it can actually be experiencing new things in that area… […] this actually goes into a deeper layer I think, about how to use technology where [otherwise it] is just 'you have to use technology' and you don't really go for what you really have to accomplish with that, and here [i.e. in this course] they do that deeper layer so I think I feel more confident about [integrating technologies], because now I know why I want to use, that I actually have to have a proper goal to go to" (NL11a);
- ✓ "there was always this kind of wall in front of me when I have to use something new, but I think that this [course] helped me get through that, that I would actually like 'ok this is new I'm going to try it' and then I'm going to see if it actually is valuable and with the whole process of different things we have to make and lessons we have to create, I think it gave me a better look on how I can see if it was valuable [or not], so it kind of structures on how I could find out […] the ICT valuable for the lesson"(NL11b);
- ✓ "sometimes I use it [i.e. technology] because it's fun. But that's not always educational, so a good thing in this minor [is] I think I will see more the educational sense of technologies than before, so, there my thoughts my vision changed, like […] 'can students learn from it?' that's the main thing" (NL13b).

Whereas several of the single factors' means did not significantly change, as described, something changed in the patterns of answers of the participants. In fact, when looking for Daan, it appeared that he was not the typical Dutch student-teacher anymore, as a discriminant function analysis on that very clustering strategy would result correct only for 19.8% of the post-questionnaire respondents[101]. To further investigate modifications between the beginning and the

[101] For further details on this analysis and the emerging new profile of respondents, please see §D – Chp.2.

end of the student-teachers' academic journey for technology integration, multidimensional scaling and network analysis were used once again.

The text will now report on post-questionnaire multidimensional scaling (Figure 3.6), and second-round interviews' (N=13) codes mapped through the Epistemic Network Analysis software (ENA - Figure 3.7), in terms of clusters of items and codes, and modifications through time.

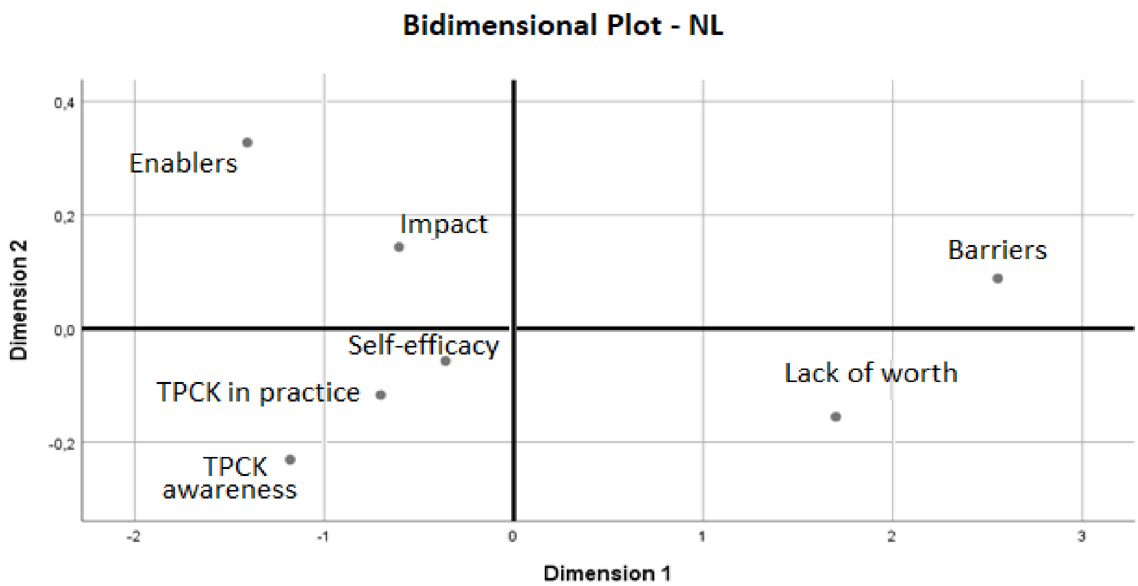


Figure 3.6 Dutch post-questionnaire respondents'' dispositions (multidimensional scaling, N=11).

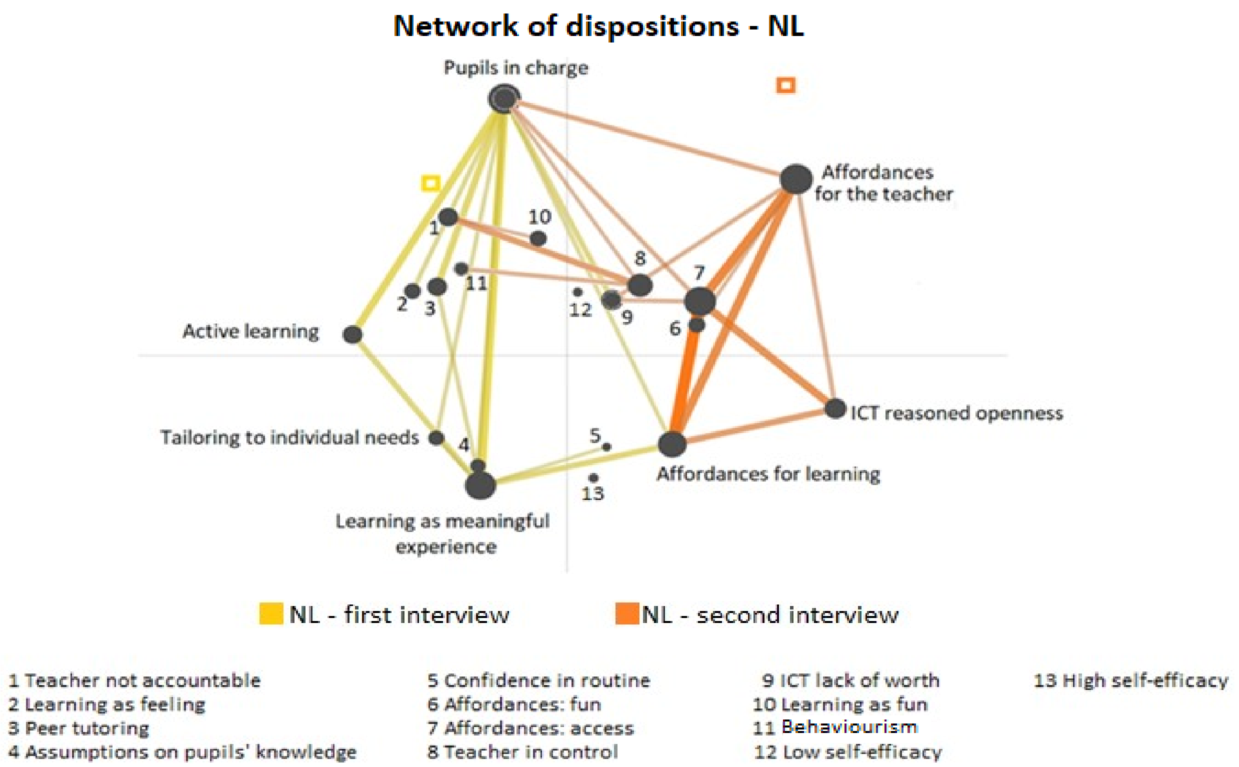


Figure 3.7 Network of dispositions - NL first and second interviews (connections among codes).

Figure 3.6 shows already some interesting modifications in Dutch responses, as measures of *TPCK awareness* and *practice* are now nearer than before, both now joined by *self-efficacy.* A similar clustering could be seen in Figure 3.7, where codes relatable to self-efficacy (5 – *confidence in routine*; 13 – *high self-efficacy*) gravitate near the positive side of the approach to technologies: *affordances for learning* (as indicator of *impact*) and *ICT reasoned openness* (interpreted as indicator for *TPCK*).

Moreover, although the perception of *lack of worth* of technologies and the *emotive barriers* still figure at the far end of the spectrum (on Dimension 1, Figure 3.6), they moved slightly apart from each other, in the post-questionnaire. As for the discourse network, *lack of worth* (9) seems to maintain the link with instances of *teacher in control* (8) already of the earlier findings, but now connects also with *affordances for access* (7). Examples of this could be: "small talks with the students, that's something ICT I think can never replace [so it's not worth it]" (NL4b); "because they can do more with paint and with colours, I think, than on the computer because that's [i.e. real painting] their own thing, and on the computer you just have [premade] examples and things" (NL1b); "you can't use everything on the school, you can't use Facebook anymore because of the privacy" (NL2b); "I think that in school you always need the teacher to teach you something, technologies can't do it" (NL7b); "I think that's very important because you can see it on a screen but I think it's more valuable to actually talk to a child, because mostly they can express themselves better in words than just typing out something" (NL11b). These findings seem to suggest different underpinnings for technology avoidance, which would be advisable to further investigate.

Furthermore, the second-round interviewees would make less comments on the central role of *pupils* in the learning experience, increasing instances of *teacher in control* (7) and *not accountable* (1) in turn (e.g. "I have to tell them about content" -NL1b; "you have to give them [i.e. pupils] new knowledge, and that's why you are a teacher of course" - NL4b; and "I don't need much [preparation] because I think I'm in my third year [at university] so I already know so some things just go along like the way they should, so I don't think I have to go through every little point [of a design]" – NL9b; "I let them choose if they want to write along, if you want to just listen you just listen […] I just let them do their own thing, and you'll see the serious students who will write soon enough […], most of the less serious students they just hang around and just listen, and some of them will interact with you some won't…but that's whatever" – NL12b).

Stronger connections now join indicators of technologies' *impact* (i.e. *affordances for learning*) with *access* to the content (7) and teachers' ease (*affordances for the teacher,* also increased in frequency) with a shift of interest accounted also by the new position of the centroid in the picture. This might suggest that in this second interview, participants were really engaged in technological related dispositions entailing their educational uses to the service of teachers during the learning experiences.

3.3 SUB-QUESTION 3: PR SHOWN IN TPCK-INFORMED DESIGN TASKS

The third research sub-question (§B- Chp.1) investigated student-teachers' pedagogical reasoning when performing TPCK-informed design tasks. These were observed twice: when participants were at their first experience with this kind of task, and after they had multiple experiences (i.e. two). Data was collected through focused interviews (Cohen et al., 2007) with a semi-structured protocol (§Chp.3.3), each one lasting 30 to 45 minutes per participant, per session.

In the next paragraphs Dutch findings will be described for this research sub-question, considering both the first and second design cycles. First, the most and least mentioned reasoning dimensions will be introduced, using as lens the PR adapted model already described in §B-Chp.3.1 (Picture 3.3). This, to better detect any match between the reasoning instances shown and the task procedure's possibly intended ones.

Picture 3.3 PR adapted model in design tasks.

Then, it will be described how participants would talk about the teacher and pupils' roles[102], technology's role, and any coherence or link among the different decisional turning points mentioned. To do so, the ENA software for data visualization will be used. Finally, and to further approach the core of this research, it will be inspected if and how student-teachers recognized a connection among their concerns and decisions when performing a technology-enhanced design task, and their given guidelines.

[102] Although these could rightfully be considered instances of pedagogical beliefs (hence considered in the second sub-question), in this section only factual and situated descriptions of roles are considered, as clear intentions/decisions for action.

AT THE BEGINNING OF THE ACADEMIC JOURNEY FOR TECHNOLOGY INTEGRATION

Once completed the first design cycle, Dutch student-teachers (N= 13) would mention concerns relatable to several reasoning dimensions, although providing different explanations. Figure 3.8 displays the percentage of interviewees expressing to have thought about issues connected to the PR dimensions.

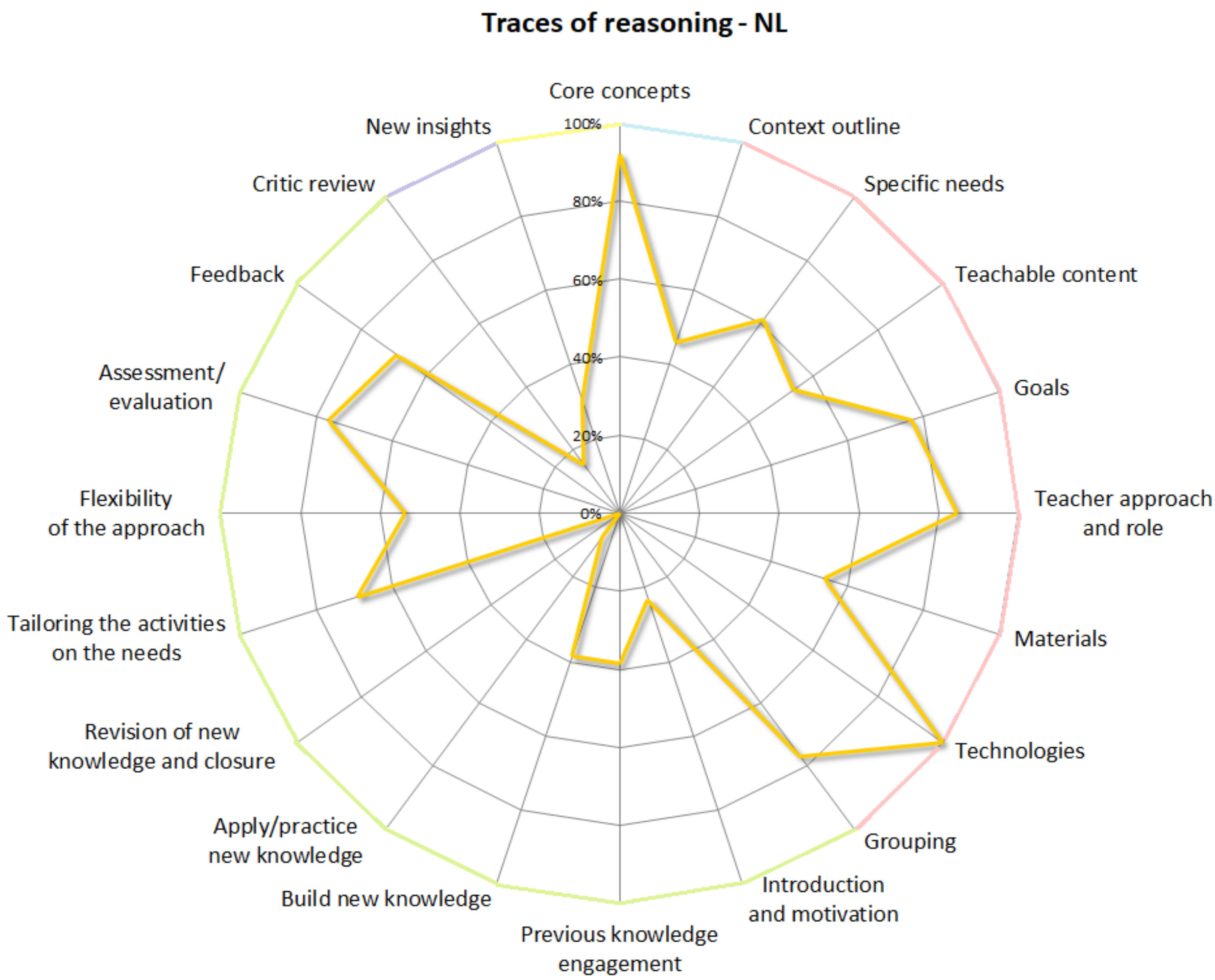


Figure 3.8 Traces of reasoning - NL first interview (frequencies).

From a first look to the figure, it seems the participants would deal mostly with the areas of *subject matter comprehension* (light blue wedge) and *enabling connections – transformation* (light red wedge), with less concerns about the *teaching and learning* (light green wedge), *reflection* (purple wedge) and *new comprehension* areas (yellow wedge).

Going more into detail, almost every interviewee (92%, n: 12) would allude to the importance of the understanding of the *subject matter* at stake in the learning unit they created. In most cases, the specific content within a discipline was the first information participants would disclose when talking about their first cycle design products. When asked about their deep knowledge about the chosen content, a few (24%, n:3) would delegate the choice just to National curriculum requirements (e.g. "this is what the government says we need to learn, so" – NL7a), whereas many (46%, n:6) would give more details in terms of what pupils would be required to do (e.g. "that was the topic of the lesson: they [i.e. pupils] have to name different parts of a volcano, where volcanoes are the most on the world and different kind of volcanoes" - NL5a) and fewer (24%, n: 3) would actually explain the disciplinary concepts implied (e.g. "[my topic in history] it's when the time period where there is something new invented and there are some familiar [alternatives, still] and you have the old period and new period, like two things you use at the same time" – NL12a).

Moving to the *enabling connection/transformation* reasoning dimension (light red wedge), there are some interesting findings. About half of the first round interviewees would spend time dwelling about the *context outline* (46%, n: 6) and its *specific needs* (62%, n: 8), mentioning issues related to the Dutch school system[103] (e.g. "[if the pupils are sent to a higher order secondary school] when the rhythm rises you'll see that some won't be able to cope with rhythm and then just start to slack and sit back, […] and that changes the vibe of a class, the way they interact with each other, that's very different in [lower and higher types of schools] because they're very different people, very different children all right there, all their view and say on things" – NL3a); or to the specific pupils with whom they would have to deal (e.g. "[the] context, I think about it and then I can use my skills about the school, classroom, how the ICT are used and [think what can] make my lesson for these ones or for practice better" – NL10a; "[I have] in my head like how many students I have, which [age] group I actually want to make it [i.e. the lesson] for, what do they already know about the subject" – NL11a; "[my lesson] it depends on the class I have, it depends on how much they're independent and how they learned at elementary school" – NL13a).

Even the reasoning quotes related to making the content accessible to the pupils (*teachable content*) were found in 7 out of 13 interview transcripts (54%), with expressions of lexis simplification (e.g. "about the details, I can explain a lot more about how [volcanoes] exist and how they [behave]…I can say a lot more but in the lessons I keep it [short and simple]" – NL4a), connections to the pupils' real-life experiences (e.g. "because [the topic is] pretty vague, and I can say that of mostly of history subjects itself, you can tell all of the stuff about what has happened, but the students are more interested in what is happening now and can it correlate to what happened before? So if you give them some examples [it's easier for them]" – NL12a), or pedagogical solutions (e.g. "if [the lesson for a] few children is maybe too hard and others maybe too simple, that's because this lesson isn't really simple but because they work in groups they are there to learn [from] each other" – NL9a).

Speaking of *teacher approach* and *role,* it was commented upon by 85% (n:11) of the interviewees, mostly (54%, n:7) indicating a teacher with a peripheral role who wants children be

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[103] See also §B- Chp.4.3.1.

main characters in their learning experiences, for example: "[a topic] it's best learnt when they [i.e. pupils] can try, they make mistakes and get better their own mistakes, because if I tell them 'you have to do this and this and this', they might do it well, but they don't understand" – NL6a; "the teacher is kind of there to support them [i.e. pupils], so it's not a teacher role but more a supporting role, so ask some questions when they actually don't manage to do something, and they can ask the teacher questions, but the teacher can't really answer the question, [he/she] has to ask them again, like 'why is this that difficult? What do you think went wrong?' so actually make things come out from children instead of explaining to them" – NL11a. A small minority (15%, n:2) would abdicate completely to their role in favour of the pupils taking the lead: e.g. "I think makes it easier for teachers if the pupils know how to work and [are] more independent […] in how they learn, and you only have to give them the handles on how to develop the self-learning so you don't have to teach them" – NL8a; "I also ask the class, I think it's very important to know how they [like] working, I can say 'you have to work in 2 groups, which I made', but if they don't think it's fine, who I am to say 'no you have to work in the group!' " – NL10a.

Another issue brought up by every interviewee, was the use of *technology*. The main reasons to use disclosed were visualization and access information (e.g. "I made it very visual for the eh for the children" – NL7a; "you can put some google maps views and put some layers on it and [see] exactly where volcanoes are and what [Maps shows] you it's that different layers, you have different kind of maps you can view so you can see, view damage, and you can view policies did to prevent it, you can see all that in different maps" – NL4a; 69%, n: 9); or to enable pupils' personal expression ("[I want to use technologies] to get them [i.e. the pupils] the most creative freedom, they can really make something that they want to make and not something that someone else wants them to make and I really think that when kids do it on their own, they can really shine on that" – NL8a, 24%, n:3). Other interesting, albeit not highly frequent (15%, n: 2), reasons to think about technology use regarded a *tailoring* intent, for example: "boys want to try a lot of things physically, and they tend to get a bit bored quicker when they use iPads, but the girls really like it [i.e. technology] and if I have a lot of girls in my class, they want to use iPads more to train this kind of stuff [i.e. circuits] less physically, [and] I think they learn more this way" (NL6a).

When moving to the *teaching and learning* dimension (light green wedge, Figure 3.8) just a few expressions were reported dealing with the classroom-based activities like *engaging previous knowledge, building /apply/revise new knowledge.* Actually, 92% (n: 12) of the participants would list the activities they planned to perform with their pupils, but their description would seldom go deeper into the reasons why they chose an activity over another, especially in terms of building new understanding, for example: "I designed two assignments: one was that children can make a letter, like a journal letter, and they have to be a Jewish kid in the timeframe of the second world war […] and they have to design the letter in a way that it looks authentic in a way, you know? So they have to alter the look of the letter to make it look something that was from the time I guess…so that's very important and I think because they have to write a small script when they do the video" (NL3a); "they [i.e. pupils] had to search a few things up in the internet, I gave them some sources, so that they don't go all around the world wide web and use unreliable sources" (NL9a).

Nevertheless, some would indeed think about the impact of the chosen activities and materials on learning (e.g. "that's also why I did this lesson, why I made [pupils] filming each other with ICT and then they present it…if you make [them] play it, live in front of them, [they] can see [themselves] back, and that's the part where ICT is very important because you can see yourself back, and say 'no it's not good let's do it over', and you can see 'oh no the information that we said there wasn't right so we might do it another way' and you can watch the movie [with] the whole class and reflect on it with the whole class" – NL5a).

Several Dutch participants would report dwelling with the issue of *tailoring* their actions to the pupils with whom they would work, considering different learning characteristics (e.g. "some people are always thinking in music […] in math or thinking in pictures and you see, the children thinking in pictures they make a big picture and like explain it [i.e. their learning] by the picture…some other people are always thinking in music, they make a song about volcanoes you know and that's how I see it" – NL5a; "[in my activities I am] choosing, well, the least amount of resistance from my pupils, to learning" NL3a) or levels ("[if you have faster students] you can make it [i.e. the task] a little more difficult in very easy steps, in my case I could add there another layer [to the Maps], to make it a bit more complex" – NL4a). Awareness was reported also on the relational/emotional conditions to the learning experience, for example "if they [i.e. pupils] don't feel comfortable or they don't feel safe in anyway or afraid of something, socially or like with the assignment, they don't learn anymore. So, at first [I] solve the [problems], because if I don't a few students won't work, they won't pay attention anymore because they will be in their shell" (NL6a).

Finally, 10 out of 13 first-round interviewees (77%) would report clear instances of decisional processes related to *assessment*, sometimes still indicating the active engagement of pupils in the matter (e.g. "I made a rubric to evaluate [and I gave it to the pupils] so they can actually check their steps by themselves" – NL2a), other times with a stronger stress on teacher control (e.g. "they [i.e. the pupils] know there are upcoming questions so they have to listen and pay attention, so they can answer the questions right, because I can see who answer guessing good and who answers guessing not good" – NL7a). The types of assessment alluded to were both process oriented (e.g. "if they grow in their learning then that's good by me" – NL8a) and product oriented (e.g. "a grading form in the assignment and that's really more about how it answers to the criteria" – NL12a).

When it comes to *reflection* and *new comprehension* (respectively purple and yellow wedges in Figure 3.8), low to none reported mentions were found in Dutch student-teachers' interviews. It is to say that when it to *new insights* interviewees could refer to their improved understanding of technological affordances and worth in education, after their first design cycle (as seen in §Chp.3.2, six out of thirteen - 46%), e.g. "well what does it [i.e. technology] give me and what doesn't it? Why don't I use the *analog* things instead of the digital things, or vice versa why don't I use the digital things instead of the *analog* ones?" NL3a). No interviewee would mention a *new insight* about the content, or the pedagogical strategies addressed, but this could also be due to the fact that these design products were not actually implemented at school, thus lacking real-life feedback that could spark these two reasoning dimensions.

A very few interviewees (n:2) would also express some *critic reflections* on the decisional process occurred (e.g. "I need to consider that maybe A will be the shortest way in which they [i.e. pupils] will understand it [i.e. the content], and B is the most useful way for them because they'll use some skills along the way, but at the end they get to the same point but in the way in which you put skills in it they have more use to it eventually, because they learn more than just the subject itself" NL12a).

Dutch student-teachers' first round interviews were mapped through the Epistemic Network Software ENA, to better visualize the focus of these conversations and the strongest connections among the issues addressed. In Figure 3.9 can be retraced, by the size of the dots, the fairly high frequency of mentions of *technology*, *subject matter,* and *assessment.*

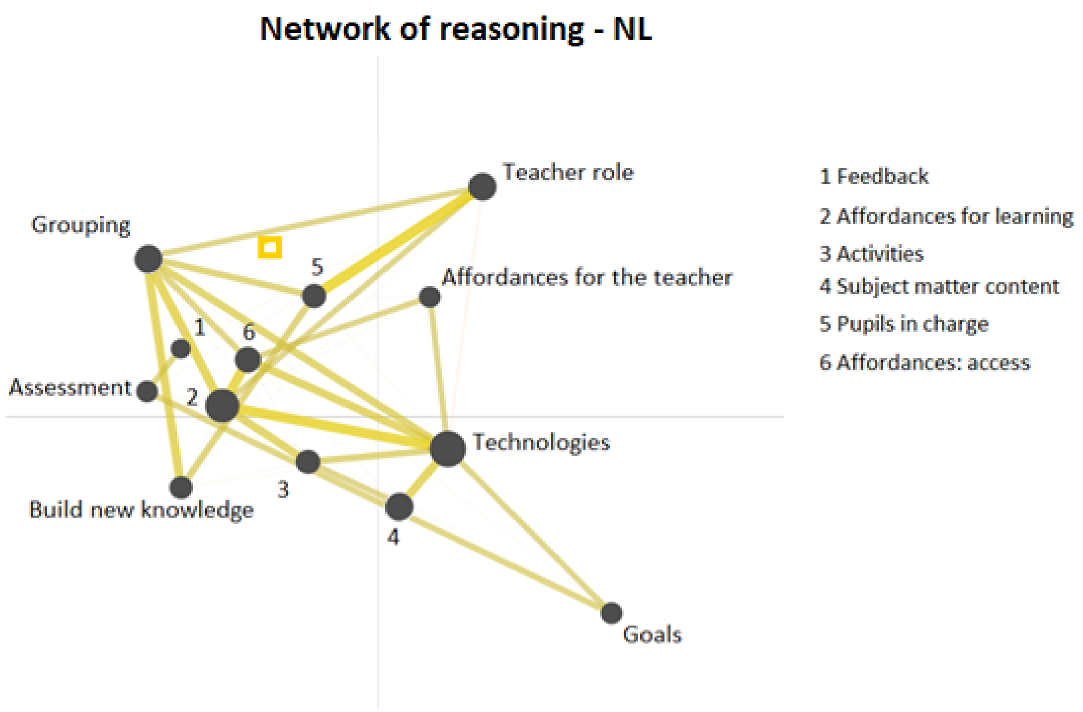

Figure 3.9 Network of reasoning - NL first interview (connections among codes).

What is most interesting in this figure is to see the lines connecting the different knots, and their distance one from the other (indicating a different role in shaping the model). First of all, it can be noticed how the thickest lines connect *teacher role* with *pupils in charge* (5) and *technologies* with *affordances for learning*[104] (2). In the earlier quotes was already clear the attention of Dutch

[104] This code was considered as indicator of technology impact, within the analysis of student-teachers' dispositions toward ICT integration (§Chp.3.2), it could provide interesting insights on participants' reasoning too. For this reason,

student-teachers towards a central role of pupils in the learning experience, with inevitable consequences on the role of teacher engaged. As for *technologies,* the concerns for content *access* (6) have already been described, but the most interesting link is now to issues of potentialities for learning, e.g.: "I tried to really make sure that children would do an optimal job at expressing themselves with the digital tools, because the digital tools were just tools, to help them reach the optimal [goal]" (NL3a); "so to make this part [i.e. the understanding of how circuit works] less scary I first let them use their iPad to build that and try and make mistakes [with no consequence], because I don't want to replace it [i.e. the physical construction of a circuit] altogether, but first they [feel] safe to try" (NL6a); "technology is a way to make them [i.e. pupils] active in the class, not that they sit and listen to me, so they learn better" (NL7a).

Technologies are also related to *grouping* codes, albeit more lightly, as noticeable by quotes like "for once it's practical, because you know someone has to hold the camera and another one has to play it, you cannot play it alone, then [the] interaction and all of that is also a good way to learn to cooperate…because if you're talking about the lesson about the volcanoes and if you group 5 people and they all look up the same information, you have 5 times the information, and with this actually [everyone] gets his own part" – NL3a; or "well you also learn a lot about yourself [in group works] like if you are a leader type you go and 'yes you have to do this and that' and you getting everybody's ideas and something like that, and someone else would be like 'I will be quiet you know' or 'I'm more the information guy' you know depends how to learn, and how you are in a group and how you can cooperate with the group and give your part as a group, and technologies can help you in this because they can give each one a part" – NL5a.

Interestingly, knots like *grouping* or *goals,* while having multiple links with the other discourse themes, are quite far from the more dense, central area of the network, indicating a more peripheral role in shaping the discussion.

Finally, the centroid (little square in the picture) would suggest that the overall focus of the Dutch participants' first round of interviews is gravitating close to the ideal of *pupils in charge*, suggesting an important weight of this issue in participants' reasoning processes.

Besides investigating the participants' PR characteristics, major interest of the present research was understanding the role of the given task guidelines in shaping these (as per main research question - §B-Chp.1). Considering the frequencies of the reasoning codes, Figure 3.10 shows the percentage of interviewees who would clearly connect the mentioned reasoning step to their task (green bars), and the ones who would firmly deny any relation to it (orange bars).

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when such code (and any other *affordance* one) was attributed to statements of general judgment and belief on the worth of technologies for learning, it was used within the analysis of dispositions; on the other hand, when it entailed some sort of detailed/concrete argumentation on the actual use of technologies in a learning environment, it was considered within the reasoning analysis.

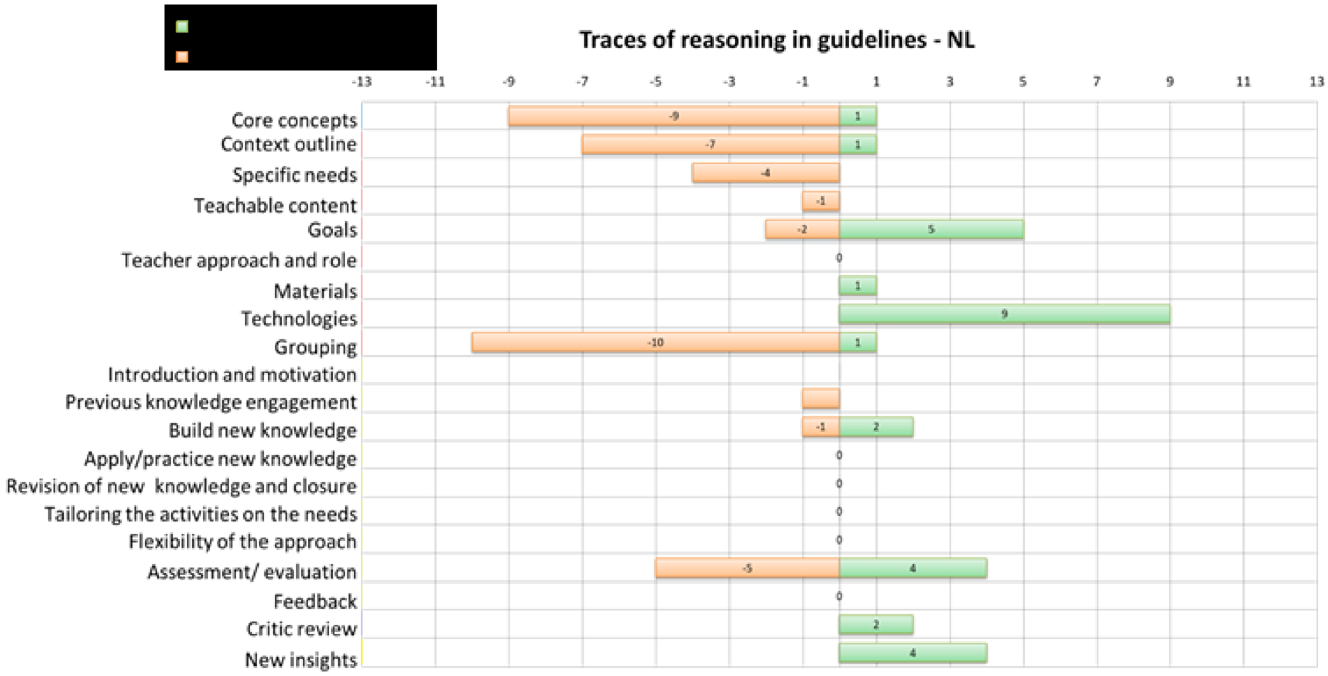


Figure 3.10 Traces of reasoning in guidelines - NL (frequencies).

It is fairly clear how guidelines were perceived not really determinant in the decisional processes to design a technology-enhanced learning unit. Quite to the contrary, while on some dimensions respondents would not express a clear judgment (i.e. *teacher approach, apply/practice new knowledge, revision of new knowledge, tailoring, flexibility,* and *feedback*), on many others interviewees would firmly state that their guidelines did not deal with the issue. Examples of the latter type of comments could be: "they did not really ask what your [topic is] in this… they just said 'go on make your lesson' " (NL9a); "they didn't ask specifically what kind of group we'd give the lesson" (NL6a); "they didn't really ask [if I wanted my pupils to work alone or in groups], I just chose for groups" (NL1a); "they didn't really ask for evaluation so I haven't thought about it" (NL2).

The Dutch interviewees who would indeed find some connection between their task and the decisional turning points they experienced, would comment for example: "[in] the beginning part so it says actually what is your goal and set clear on your paper what's your goal" (NL1a); "they ask you about the added value of technologies, mostly related to the TPACK model" (NL11a). Interestingly, 15% (n:2) of the participants recognized in their guidelines the input to *reflect* on the teacher practice (e.g. "in this part [indicates SWOT in the guidelines] we have to analyse our own lesson series, so you point out the strong points, weaknesses, you pre-evaluate your own product" – NL8a), and four of them (31%) would attribute *new insights* to the design experience and their guidelines (e.g. "I mean you're probably better at designing a Web Quest or using [one], technically, after this [assignment], it makes you think when to use it too because some things you can do better by doing it analog I guess" - NL3a; "before this exam we also thought about TPACK we also thought about 21st century skills, but you have to [make] all come together at the exam, that's something like a funnel" – NL5a).

Useful to keep in mind when reading these comments would be the fact that eight interviewees in this round (62%) reported not having used the given procedure to complete the task (see §Chp.3.1).

After multiple academic experiences for technology integration

Completing the second design cycle, Dutch student-teachers' PR mentions shifted on several dimensions. Figure 3.11 displays how the interviewees' reasoning quotes changed from the first to the second round of interviews. Before going down to the details of the changes, the reader should be reminded that in this second interview (N=13) participants were not guided in possible reasoning or design steps, but simply asked what they thought necessary to consider or keep in mind, when preparing a learning unit.

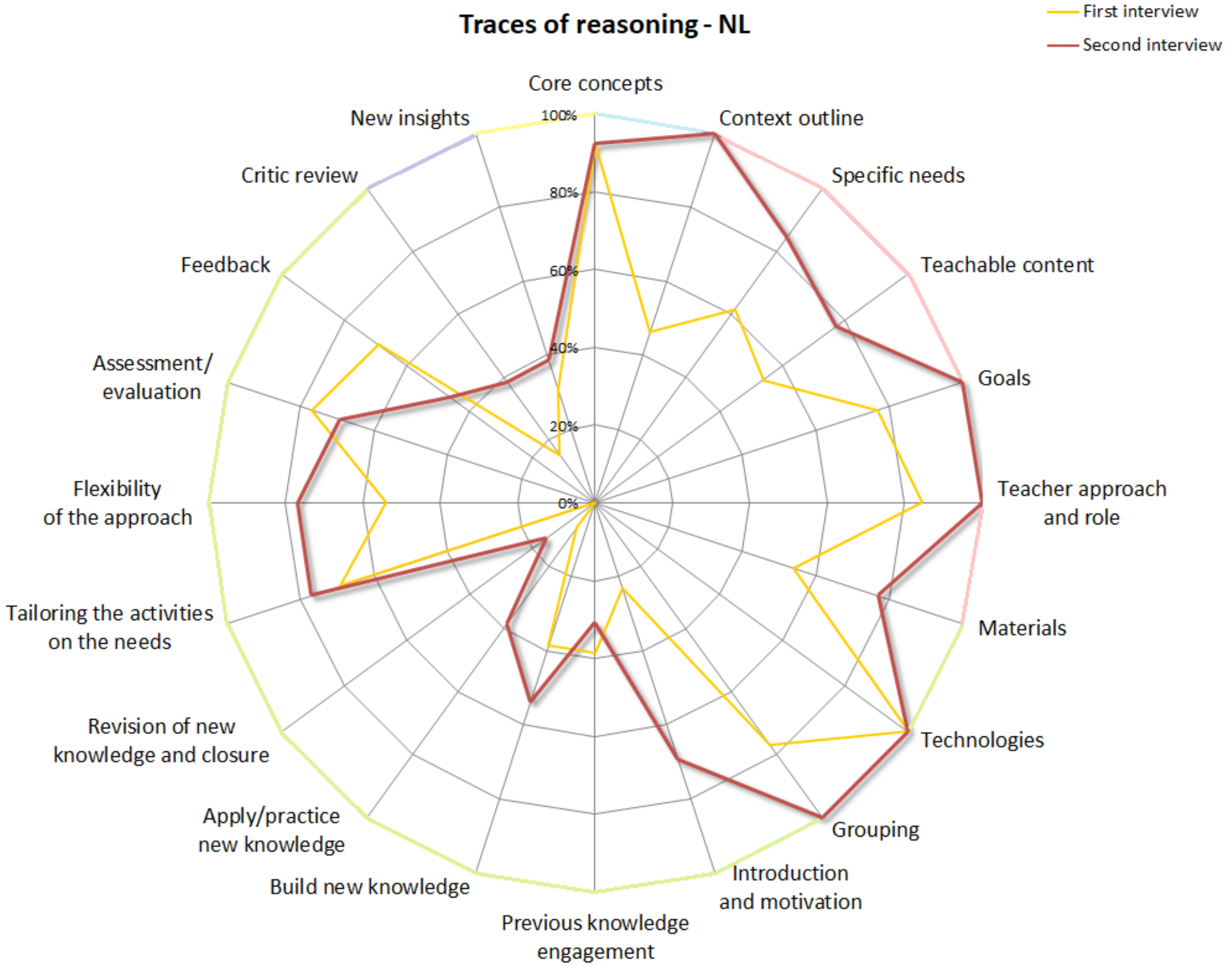


Figure 3.11 Traces of reasoning - NL first and second interviews (frequencies).

At a first glance, Figure 3.11 would suggest an overall wider engagement of PR dimensions in the second design cycle. Particularly increased seemed the comments on *contextual outline* exploration and *introduction and motivation* activities, but smaller and yet interesting changes occurred also on *teachable content, teacher approach, grouping,* and *flexibility dimensions.*

When free to talk about what perceived essential to be addressed and reasoned through in an instructional design, regardless of their design product, the *comprehension of subject matter* still holds a great primate for Dutch student-teachers (e.g. "what I always consider is what kind of subject I have to teach" – NL11b). Several interviewees would mention choosing the content in relation to the *contextual outline,* in relation to the yearly curriculum for the class (e.g. "ok, maths, but how [far along] are the students in the [yearly] planning? Because they always have a planner that you can just follow, and most of the times they're a few weeks behind, so you have a bit of slack" - NL3b; "I would probably ask 'do you have a book for the course? And what chapter are we in?' to choose the content" – NL6b), or to the *goals* already in place for these students (e.g. "like they are learning different colours in the pallet or you're learning about Van Gogh or…you have to go with the goal [they give you]" – NL1b). The *context* exploration is indeed a great concern for Dutch student-teachers, starting with the influence in the choice of the content (e.g. "when it's about religion I would like to know like the vision of the school because like every school has a different vision about how you have to teach religion" – NL2b), and the overall approach to it ("I want to know what level am I teaching? VBO, HAVO…because they are really different students" – NL12b).

In *enabling connections - transformation*, also the pupils' possible characteristics and *specific needs* seem to gain more importance: for example, "[I would like to] know what kind of children are like behind in motoric, so the motor skills, that's something I would consider because it's very important because then you can also help children who think it's more difficult" (NL11b); "[I would ask] about their [i.e. pupils'] skills, if they understand the assignments but also if they can do it, like the age or something, I know when they are 8 or 9 they can do not everything, when they are 12 they can do more with technology" (NL1b); "[for me] it's important to know if the children, they really know how to work by themselves and be independent" (NL8b). When it comes to making the content accessible (*teachable content*), Dutch student-teachers consider the peculiarity of their pupils (e.g. "I think that's important maybe which rivers cross Holland, or Belgium or….so it's a little bit closer to the students, so they are interested more than to know that the Danube is the longest river in Europe" - NL4b) and the possible teaching solutions to challenges (e.g. "I'm thinking if it's a hard subject, for the kids, and I need multiple ways of explaining, but then I also think 'ok I'm going to explain it in multiple ways, so is it confusing?' because I'm going to explain the same thing again, is it something different? Is it the same thing?" – NL6b; "when I'm explaining something like 'this subject is like this this and this, that's it', if I do that on the highest level of education [i.e. HAVO] is perfectly fine they will probably understand it, but on the lower level [i.e. VMBO[105]] I can't just say 'this vague subject's definition is like this this and this and you can see it here' and that's it. Their mind

[105] See §B – Chp.4.3.1.

would be 'what do you mean?' I have to be way more concrete and make way more steps to get them to the definition itself to make it clear to them, so that's something you have to take into consideration" NL12b). As perceivable by these comments, the *teacher role* and *approach* became even more essential in the second-round interview. Interestingly, more participants reported the need to consider the teacher in control of the educational experience, versus the more learner-centred perspective of the first interview: for example, "the only thing I need to do is give them [i.e. pupils] something to do, to look at, because the lesson itself [is] how do you give the lesson, do you just stand there and talk, or do you give them something to look at, and ask questions, so that's what I'm thinking about" (NL9b); "most of the times they [i.e. pupils] work alone, so I can see how they do it alone and not with each other, but when it goes well they can go into two and two, […] when they are a bit quiet and are ready with the work" (NL12b). Nevertheless, some interviewees would still report an approach oriented to learning and learners, for example: "[as a teacher I would be] making sure that they feel safe, they can make mistakes if they need and want to" (NL3b); "I just observe and walk around and make sure they understand things" (NL4b); "then I'm there to help the students" (NL10b). Important seems also the connection with the usual routine of the pupils in the context (e.g. "I probably will ask the sick teacher […] if he has a method or something, so I can follow that" NL13b).

Technologies maintain an absolute primate in the words of the interviewees, with reasons still related to access and visualization of content ("I could tell the students all about a Buddhist temple, for example, but if I could just show them [like through technologies] that would spark the enthusiasm of the students very much more than me just telling them or showing them pictures" – NL3b; "I think it's more easy for kids to find information on the iPads" – NL8b; "I can ah share a link or something" – NL10b), but also to different roles for these tools, for example for engaging pupils ("it's kind of different, it's not book and read and read and talk about it, it's more interactive I think, they must think for themselves and put their card up, so I can scan and they laugh about it because I walk in the room with the phone, so they like it and I think it's more interactive" – NL1b); managing discipline ("[I would be] mostly using videos because it's really easy to use and students always are quiet and they're just going to watch the video and you can just reflect on it afterwards" – NL2b; "you can use ICT, you can use non ICT, but you have to keep in mind whether or not it would make it kind of too active in the classroom, you don't want drama" – NL11b); creating drills ("if they have to make formulas and answer the formulas, they can do it on the computer, on the laptop" – NL7b; "they can ah do the exercises on their own time, not at school because I'm only at school, but they can also do homework and continue practicing" – NL10b); or to the teacher's benefit ("sometimes I use technologies because it's there, sometimes I use it because it's fun, but you know it needs more preparation" – NL13b).

Another issue brought up by 100% of second-round interviewees was the *grouping* reasoning step, with instances sometimes related to pupils' discipline management (e.g. "maybe I want to use group work but when I be there maybe they are very talking with each other and then I'm 'no, not working together, better work alone and be quiet'" NL1b); or to engagement in the task (e.g. "when you do an assignment individually it's like they usually find it quite boring, they are going to read a bit, they're going to do the assignment […], but when you have them make in groups, they're interacting with each other, like if they have to read for example, they're really going to discuss 'ok what do you think, what do I think, let's make an answer'" -NL2b). Indeed, implications for the learning process were considered by many, for example: "because if they work in groups they learn things differently than if they work alone and that's one big thing that comes out of that" (NL3b), "I think if you can explain [something] to another student you understand it, so not only the student who have [doubts] is being helped, but the student who helps the other student, he helps himself because he's busy with the subject" (NL7b).

When it comes to the *teaching and learning* reasoning dimension (light green wedge in Figure 3.11), Dutch interviewees at the second round (69%, n:9) mentioned more interests in creating an *introduction* moment, although only sometimes oriented to spark pupils' interests on the topic (e.g. "I try to think of an interactive tool to start my lesson, so for example the Dutch colonial time: I start my lesson off by handing out little pepper balls and other spices, because Holland became very rich because of the spice trade and they go all 'oh what is this? Can I eat it?' these kind of questions" – NL3b), and more often to introduce the lesson, maybe with a lecture by the teacher on the essential content to be addressed (e.g. "I am just going to describe all my lesson, like, first I will summarize the previous lesson of the course, how the previous lesson looked like […] then I will go further and I'll look at the schedule 'what are we going to do in this lesson, what are we going to learn' […] so first kind of instruction" – NL13b).

Even *flexibility* quotes increased, showing an approach open to the unexpected, like "I'm not going to plan on everything because there always can happen anything, or maybe it has happened something before class, and you can't prepare for that, if you try to prepare for that then you don't know what to do when something unexpected happens" (NL6b). Interestingly, *feedback* issues seem to hold a lesser role in the second interviews (46% over the initial 69%) as fewer of them brought up a clear decisional step on the matter (e.g. "I would just give them feedback about how they did it, during the whole process, but not by the end product, it's more about the process than the product" NL8b).

On the other hand, Dutch interviewees slightly increased in their mentioning of a *critic reflection* on their practice, for example: "like all TPACK is just 'don't put technology on a working formula [i.e. lesson], it won't make it better directly [i.e. automatically], or always!' I mean it could make it better of course, if you have a very good lesson prepared already like 5 years ago, and now maybe you could put a tool that makes it more efficient, then of course it's good but like with my project now I understood well [that] it's not [just] how technology works [in itself], you don't just put technology in a working formula and expect it [to] works in any [context]" (NL12b); "[I need to keep in mind] my position in the classroom and like at the start I stand in front of the class to introduce myself, and then think about ok when I let them work on something like maybe in the middle of instructions, or after instruction, where am I in the classroom, am I in between the students, am I waiting for them to raise their hand and then go to the students, how I make myself visible…because that's a kind of a weakness of me, that I may stand behind the desk all the time, like shielding me from all the students" (NL6b); "I even confront the class itself and I say ‘well I don’t think it’s going well, what do you think? What could we change? What do I want from you, what do you want from me?’ and that way I think you can solve a lot of things with your class itself” (NL11b). Similarly, a slight increase occurred in the *new insight* comments connected with the performance of the task, mainly in relation to technology integration, for example: “I think I became more like technology critic …first look at it, try it a few times with different things, sometimes it only works for like one aspect of the whole lesson, when you actually want to use it for like a whole lesson, and if it doesn’t work then you don’t use it” (NL6b); “I think now I understand more why technology can be such a great addition to a school or something, to a lesson” (NL9b).

When looking at Dutch student-teachers’ interview maps from the two rounds, through the Epistemic Network Software ENA, a shift could be seen in the focus of these conversations and in the strongest connections among the issues addressed. In Figure 3.12 the dark orange dots’ size shows the high frequency of codes related to *teacher role, grouping, technologies* (5) and *tailoring practice.*

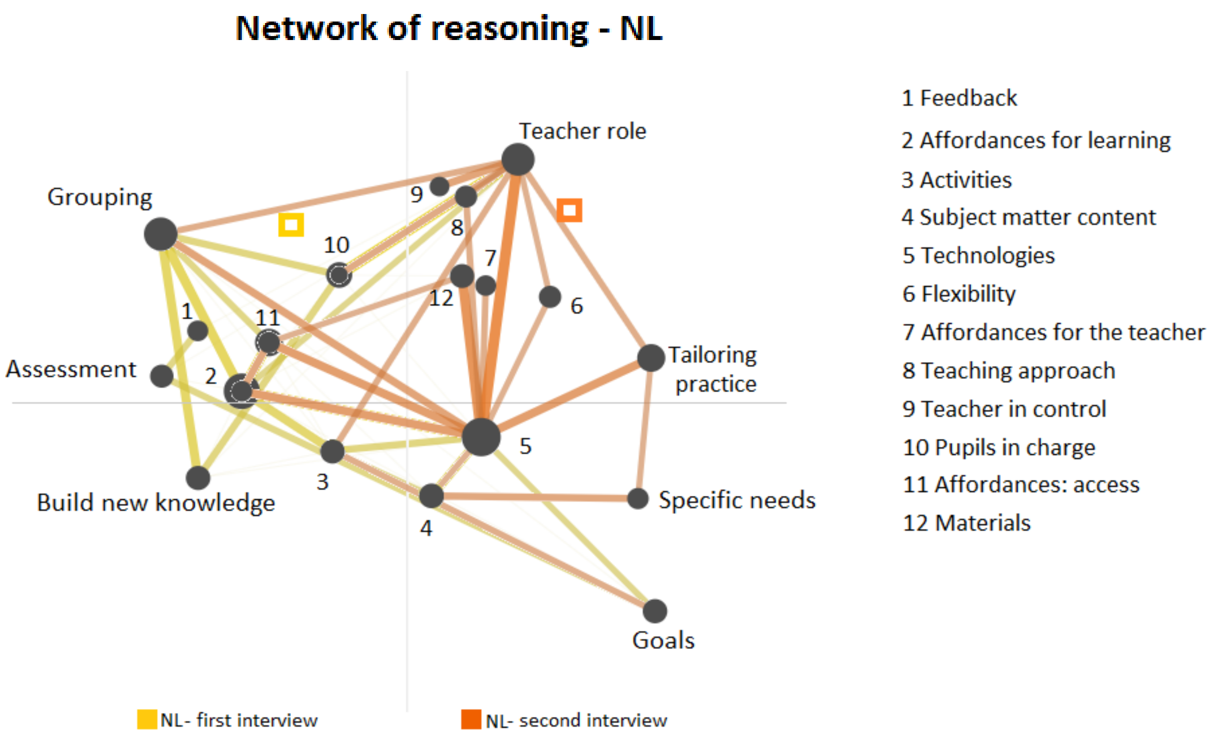


Figure 3.12 Network of reasoning - NL first and second interviews (connections among codes).

It can also be seen the slight decrease in the number of mentions (hence the in the dot size) of *pupils in charge, affordances for content access* and *for learning,* as accounted by the earlier description.

Watching the relations among the knots, the thickest lines – hence connections – link now *technologies* (5) to *teacher role* and *materials* (12) suggesting that Dutch student-teachers start to contemplate technological tool as other non-digital means for instruction and not something separate. Moreover, their shift toward a conception of *teacher* more in charge of the educational experience led them to express accountability in the choice and use of technologies, as per quotes above. On this, it is to highlight also the decrease of *affordances for learning* (2) and the concurrent appearance of *affordances for the teacher*[106] ease (7).

Newly emerged issues (dots) mainly pertain to two themes: on the one side the concerns for the context and its dynamics (with codes like *flexibility* – 6, *tailoring practice, specific needs*), and on the other the consideration of the teacher's actions and control over them (with codes like *teacher role, teaching approach* – 8, *teacher in control* – 7, *affordances for the teacher*). The last dimension seems at the core of Dutch participants' discussion, as it is very close to the second-round interviews' centroid (little orange square).

Once again, along with investigating the participants' PR characteristics and changes, the role of the given task guidelines was also investigated. Considering the frequencies of the reasoning codes, Figure 3.13 shows the percentage of interviewees who would clearly connect the mentioned reasoning step to their task, in the first (in blue) and second (in purple) interview rounds.

[106] This code was considered also, within the analysis of student-teachers' dispositions toward ICT integration (§Chp.3.2), with regards to pedagogical beliefs. As it could provide interesting insights on participants' reasoning too, whenever it was attributed to statements of general judgment and belief on the worth of technologies for learning, it was used within the analysis of dispositions. On the other hand, when it entailed some sort of detailed/concrete argumentation on the actual use of technologies in a learning environment, it was considered within the reasoning analysis.

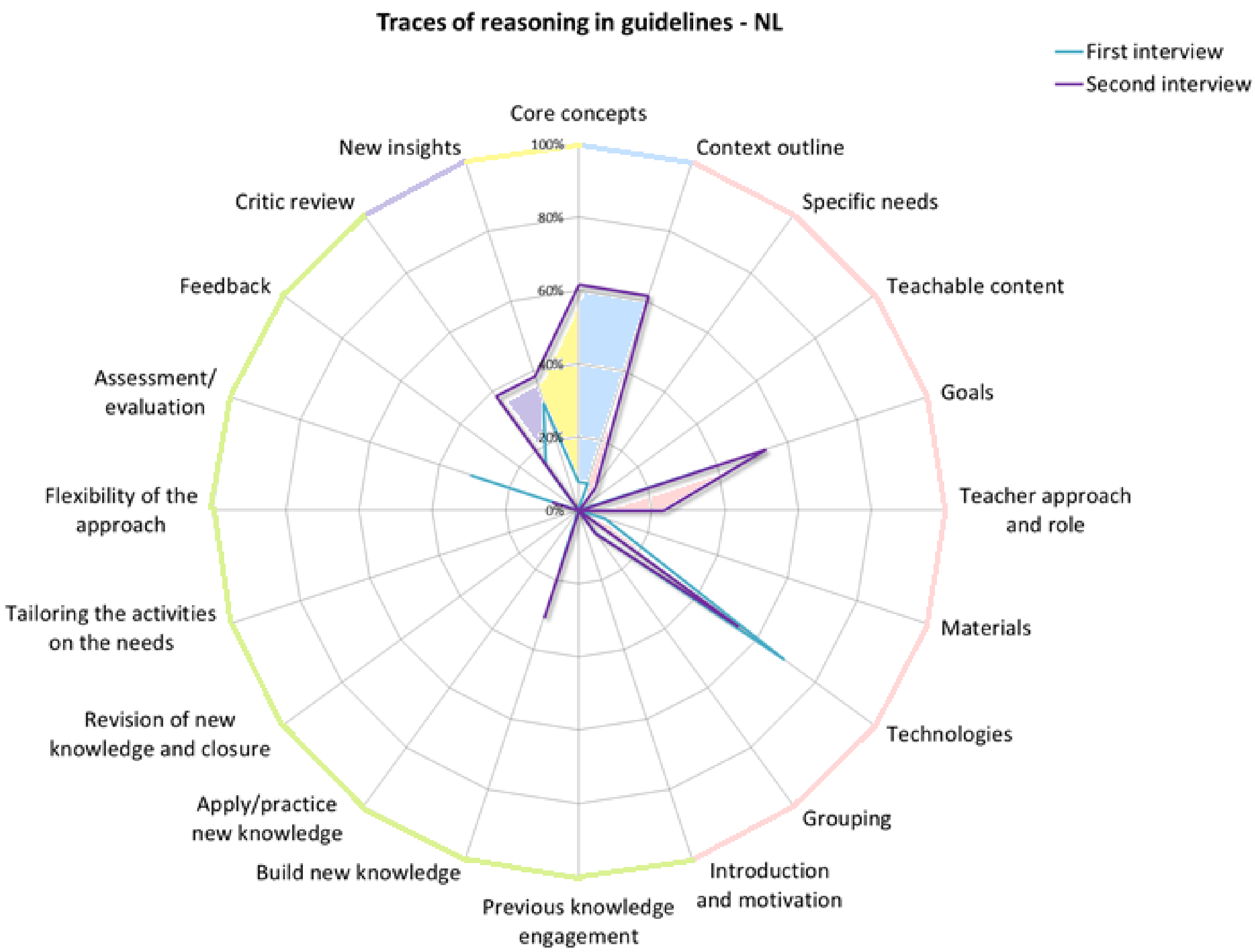


Figure 3.13 Traces of reasoning in guidelines - NL first and second interview (frequencies).

Differently from the first round of interviews, the guidelines-reasoning matching was not carried out through the attribution of reasoning to the guidelines, but from the identification of the guidelines' parts relevant to inform the reasoning. This shift in the prompt question was made to let the participants free to state the importance of the guidelines' items in helping to prepare a learning unit.

At a first glance, it seems that the perception of guidelines' role for reasoning, albeit still barely getting to 60% of participants, greatly improved in some areas (coloured in the picture), starting from *subject matter comprehension,* to *context outline* exploration, *goals* definition, *technologies'* uses and *assessment.*

Several interviewees (62%, n:8) would refer to the guidelines' items to introduce their ideas on the *content* (e.g. "when I have to teach I have to teach a subject [points to item 3.1[107]] and the subject could be anything history related, but I think you can split it in the content [points at IDP 3[108]] and the goals [points at IDP 2.1[109]]" – NL4b). Others, to talk about the *goals* (e.g. "you get new knowledge [points at IDP 2.1] because

[107] As per §Chp.3.1, item 3.1 reads "subject matter".
[108] As per §Chp.3.1, item 3 reads "lesson content".
[109] As per §Chp.3.1, item 2.1 reads "new knowledge/abilities".

you first [consider] the skills and with that skills [i.e. previous skills/learning conditions] you can create new knowledge" - NL7b), or within decision on *classroom-based activities* (e.g." students actions [points at IDP 4.1[110]] and learning activities [points at IDP 4[111]], those two are the real two way roads, they are really central to your lesson" – NL3b).

Interestingly, when choosing which guidelines' items, they would consider relevant for their reasoning process in creating a lesson, Dutch interviewees still made some mismatch between items' labels and definition, suggesting possible misunderstanding (or lack of familiarity – see §Chp.3.1). Examples of this could be: "first in my lesson you have the skill your pupils already have [points at IDP 3.2[112]]" (NL7b); "actually background approach [points at IDP 1[113]] so that's kind of like their starting point, right? For the children?" (NL11b); or "background approach [points at IDP 1], that's a good one about the students' background, [do] they know ICT, is there any student I should look out for?" (NL13b).

Furthermore, more than of the second-round interviewees (54%, n:7) commented on an intertwined conception of design components "when I think more about it, I think every [part] is related with everything, a little bit" (NL1b); "that's the nice thing about education, everything is related" (NL13b).

On the other hand, fewer interviewees than before would comment on the relevance of items to decide about the features of their learning unit. Sometimes interviewees would mention the irrelevance of the issue, for example "SWOT [points at IDP 10.1[114]] here, I do something, but not every day, sometimes there is someone looking me, after the lesson we talk about it, they will ask 'how do you think it was going' and then I have to self-analyse, but I don't think it's necessary every time" (NL1b); "time [points at IDP 8[115]] I think isn't that important, it's something I didn't think about" (NL8b); "why do I have to talk about location [points at IDP 9.1[116]], it's just in the classroom" (NL9b); "resources and teaching materials [points at IDP 6[117]] …I think the students they will always have a book or a laptop so I think that's always a thing that they take to school so this [points at IDP 6] is naturally to have it so I don't take it into consideration" (NL10b). Other times, they would comment on the perception of an artificial categorization provided by the guidelines, not reflecting their actual reasoning process on the matter, for example "so lesson content [points at IDP 3] is actually what you are going to teach, so that kind of overlaps with the goals as well [points at IDP 2[118]]" (NL11b).

[110] As per §Chp.3.1, item 4.1 reads "students' actions".
[111] As per §Chp.3.1, item 4 reads "learning activities".
[112] As per §Chp.3.1, item 3.2 reads "skills", whose definition is: "description of the topic in terms of specific soft skills implied", here interpreted as pupils' previous knowledge more than as expert comprehension of the subject matter by the teacher.
[113] As per §Chp.3.1, item 1 reads "background approach", whose definition relates to the teacher approach to the learning unit, in terms of learning theory/ies and broad vision for the lesson.
[114] As per §Chp.3.1, item 10.1 reads "SWOT".
[115] As per §Chp.3.1, item 8 reads "timeframe".
[116] As per §Chp.3.1, item 9.1 reads "location".
[117] As per §Chp.3.1, item 6 reads "learning sources and teaching materials".
[118] As per §Chp.3.1, item 2 reads "learning goals".

Finally, *critic review* and *new insights* improved slightly in the second round of interviews, and were always linked to the task, suggesting a possible influence on a more conscious understanding of the teaching profession and the design practice in particular.

3.4 DUTCH CASE ANSWER TO THE MAIN RESEARCH QUESTION

The Dutch case study engaged 13 pre-service teachers who were training to become either generalist teachers at primary school or specialist ones at lower-secondary level (§B-Chp.4.3.1). Within the Dutch context, these types of teachers would work without a strict national curriculum (albeit in agreement with attainment targets), in schools where pupils are sorted also according to their academic performance, and with a separation between mainstream and special need education (§B-Chp.4.3.1). Furthermore, while national policies equipped almost the totality of the schools with up to date technological equipment (Smeets & van der Horts, 2018), technology use in education is not laid down by law (Eurydice, 2018c).

Specifically, participants to this study (aged mainly 17-22) were attending what they stated being their first academic experience for technology integration in in education[119] and most of them did not have any previous teaching experience (§B-Chp.4.3.4). These student-teachers entered the observed academic course reporting wide access to digital technologies[120] and fair interest in engaging with them. Their familiarity with the personal use of ICT was just on the average, and they stated to be quite new to the technology use in education (§B-Chp.4.3.4). On the other hand, they were very keen on entertainment- and internet-based uses of technologies. Overall, they seemed sufficiently appreciative of the surrounding encouragement and academic support to integrate technologies in education, which remained consistent through the course. In time, they became significantly more familiar with both common and educational technologies, realizing the course's mission to answer the societal demand for technology-savvy teachers (§B-Chp.4.3.3). Furthermore, they are in line with other researches stressing the positive impact of design processes in offering "meaningful exposure to technology integration in educational contexts" (Baran & Uygun, 2016, p. 48) and enabling (future) teachers to make "informed decisions" on the matter (Conole & Willis, 2013, p. 28).

Along with an increased familiarity with common and educational technologies, participants showed some slight change in their dispositional factors toward ICT integration. Dutch student-

[119] At least at university level.
[120] Almost everyone stated to own at least one device connected to internet (§B-Chp.4.3.4).

teachers entered their course with very positive emotive signposts and self-efficacy measures, although when focusing on technologies' worth (and lack thereof) in education, they were a little more cautious (§Chp.3.2). Their pedagogical beliefs focused on the strive for meaningful experiences in which pupils are in charge of their learning and the technologies' affordances are to the service of the learner. Nevertheless, a small but significant reference gathered the idea of teacher in full control of the educational experience and sceptical about technologies, accounting for the sometimes mentioned perception that technologies might undermine the educators' role in the classroom (see Crompton, 2015). Dutch participants' ambivalent pedagogical dispositions stirred towards a more teacher-centred perspective through time, with the increasing value attributed to an empowered teacher, in control of the educational experience and using technologies to his/her advantage (§Chp.3.2). This could also relate to the slightly higher measures of emotional barriers and perception of lack of worth (still low overall), which could account for a more aware and wary consideration of technologies. Nevertheless, by the end of their academic course, participants became significantly more conscious of the possibilities to integrate pedagogy, content and technology, relating such understanding to their (average) self-efficacy and maintaining an overall very positive approach to technology integration (as per *emotive enablers* and *impact* indicators - §Chp.3.2). As reported in the literature, teachers' understanding of how teaching/learning experiences may benefit from the use of technologies, associated with a good dispositional configuration towards technology educational use, could greatly influence the intention and possible enacted behaviour to integrate (Ertmer & Ottenbreit-Leftwich, 2010; Joo et al., 2014, 2018; Kimmons & Hall, 2016; Petko, 2012).

Furthermore, in the student-teachers' words grew the relevance of technologies' affordances for accessing content and the willingness to incorporate these means in the teacher's professional toolbox (*ICT reasoned openness* - §Chp.3.2), with an interesting attention for the entertainment potential of technologies for learning. These kinds of added value attributed to technology use seems to align with what already found in other researches engaging Dutch teachers (e.g. Heitink et al., 2016, 2017; Smits et al., 2019), who would mainly identify affordances for attractiveness for the pupils and efficiency for the teachers (Smits et al., 2019).

Said dispositions' configuration could be recognized in informing participants' reasoning showing the great influence already known in the literature (see, e.g. Farjon et al., 2019; Smart, 2016; Tondeur et al, 2016). During their first design task, Dutch student-teachers' reasoning was very concerned with deliberations about content (*comprehension*), in relation to a contextual analysis focused highly to the specificities of school and pupils' types (see §B-Chp.4.1.1). Such considerations would then inform decisions for flexible and tailored practices (*teaching and* *learning*), in which learning assessment held a discrete relevance (§Chp.3.3). In their words, the teacher approach (*enabling connections/transformation*) was aimed to ensure pupils' active engagement in the learning experience, in alignment with the learner-centred dispositions already mentioned. Furthermore, participants seemed very keen to reason about technology selection and integration, with motivations mainly linked to content access and visualization.

Through the course and two design cycles within, these participants became even more concerned with the educational context details, focusing on a clear definition of situated content and goals, to be aligned with the overall pupils' educational background (*comprehension* and *enabling connections/transformation*). Here it can be detected an improved awareness of the broad educational system in which these student-teachers will be called to operate, for example in relation to the performance-based school system or the lack of special need students attending mainstream education (§B-Chp.4.3.1). Once again, the underlying dispositions aligned with reported decisional steps for a teacher more in control of the educational experience, albeit concerned with the learners' specificities, e.g. through tailoring strategies (§Chp.3.3). Technology integration maintained its importance in participants' reasoning as they became more concerned about how to use it to make the content accessible for the pupils and support discipline management (*enabling connections/transformation* dimension). At the end of the observed course and two design cycles within, the configuration of participants' reasoning was mostly focused on decisional steps taken outside and before entering the classroom (*comprehension, enabling connections/transformation* dimensions), although accompanied by fair stances of flexibility and tailoring once the lesson is in-action (*teaching and learning* dimension). Such findings may suggest a positive growth in student-teachers' interest for carefully prepare their action, although the increased centrality of the teaching role may carry the risk of overshadowing that of the learning dynamics (see also Heitink et al. 2016, So & Kim, 2009). It is to highlight that the participants tried out their design products in real school contexts, facing some difficulties in relating with its educational demands (§Chp.3.1). This could help explain why they resorted to a more teacher-centred reasoning, maybe perceived helpful to manage discipline and direct content learning in an unfamiliar context. On the other hand, through the second design experience, Dutch student-teachers grew more critical about their practices and reported some new comprehension about the educational practices (*reflection* and *new comprehension* - §Chp.3.3), which would pose as promising seeds for an ever-improving professional expertise (see Loughran et al., 2016) based on a critical appreciation of what, why and how they do what they do (Angeli & Valanides, 2018; Heitink et al., 2016; Nilsson, 2009; Smart, 2016). Indeed, as reported in the literature, the described findings about underpinning positive dispositions and emerging reasoning dimensions would suggest favourable conditions for future meaningful practices of technology integration (see Forkosh-Baruch, 2018; Kim et al., 2013; Ertmer et al., 2012; Joo et al., 2018) identifiable in the teachers' "conscious alignment between specific learning goals for their content, (content specific) pedagogy, affordances and limitations of technology and teachers' and pupils' roles in order to produce meaningful learning outcomes and to prepare students for life in a digital world" (Smits et al., 2019, p. 93, see also Farjon et al., 2019). To realize such potentialities, it would be useful to capitalize on the empowerment of the teacher role and TPCK awareness perceived by the student-teachers, though supporting their enactment primarily to the service of learning and learners.

The main research question wanted to see the possible link between these reasoning processes, informed by underpinning dispositions, and the very design tasks student-teachers were required to perform. What was the role of the Dutch design task procedures and experiences, in sparking the kind of reasoning detected?

In the participants' words could be recognized the academic lexis related to the theoretical references of the design task and guidelines, which likely contributed to their increased theoretically-based TPCK awareness (as per questionnaire - §Chp.3.2). Indeed, Dutch student-teachers would refer widely to the TPACK framework (Mishra & Koehler, 2006), SAMR (Puentedura, 2006) and Meaningful Learning (Howland, Jonassen & Marra, 2011) models using the definitions introduced during the academic course (§Chp.3.1) to talk about their decisions to integrate technologies. Designing a technology integrated learning unit (and with the specific given guidelines) was a new experience for most of the interviewed student-teacher, although several did not use the mandatory guidelines in performing their design, preferring to resort to pre-made materials or personal experiences. It could be possible that such initial choice related to the little recognized connection between what participants reasoned about, and what they were required to perform. To the contrary, many would clearly deny any link between the two on some issues (§Chp.3.3). It is to say that at first, eight participants thought the task guidelines were unclear and some were not satisfied with the support received to understand them. In the second design cycle, student-teachers did not become more familiar with the task or its guidelines, which were once again not used by half of them. While they grew keener in using educational technologies, and appreciative of the potentialities to integrate them, the given guidelines gained just slight recognition of relevance in shaping the design reasoning for technology-integrated instruction (§Chp.3.3). At the end of the academic course and two design cycles within, on no dimension there was a perfect match between task prompts and reasoning instances in the Dutch participants' words, with the exception of *reflection* and *new comprehension.* Aside from them, the design procedure was found most significant in triggering considerations about content (*comprehension*) and goals definition, context exploration, selection of technologies (*enabling connections*), and realization of actions to improve pupils' content knowledge (*teaching and learning*). On the other hand, most decisional steps were perceived as unrelated to the task performance requirements.

All in all, the Dutch design task and guidelines appear to have had moderate impact on student-teachers' dispositional factors, although it made them more aware of the theoretical possibilities for ICT integration and secured a positive and confident approach to the matter (similar results, e.g. in Tondeur et al., 2017, 2019). These findings would suggest a good underlying ground for positive attitudes and intentions to integrate (e.g. Farjon et al., 2019; Kim, 2016; Knezek & Christensen, 2016; Voogt et al., 2012). The direct relation to instances of reasoning was weakly recognized, although task guidelines gained some importance in participants' words though time. Indeed, while several of them did not use the given guidelines to perform their design task, at the end of their academic course five would find some worth in using them in the future profession. The observed task and procedure seem to have influenced participants' *critic reflection* and *new comprehension,* which might suggest a more conscious understanding of the teaching profession, as found also in the instances of net-like reasoning relating the different components of design. This could suggest a more mature consideration of the intertwined and situated relationship among all the components of the reasoning process for technology-integrated design (see also Koehler, Mishra & Yahya, 2007; Smart, 2016; Starkey, 2011). On the other hand, the task seems to have weak impact on the other reasoning dimensions, although further research would be advised, possibly with participants indeed using the given guidelines.

Moreover, the elective stance of the guidelines' use could have played a role in the spark of a cognitive conflict on the profession conceptualization in student-teachers, many of whom expressed the same theoretical framework they happened to work with, but did not express their overall reasoning accordingly. Furthermore, the requirement for participants to implement their design product at school (in the second cycle), gave some interesting insights on their practice-based reasoning. The fact that participants chose to resort to familiar mental schema and routines routed in their personal experience figures as interesting input to expand the research addressing the specific Dutch student-teachers' reasoning characteristics. From the reported findings it is to highlight how these participants, free to state the relevance of the guidelines in shaping their reasoning (i.e. in the second interview), recognized an albeit limited impact of the guidelines, which co-occurred with a stronger teacher approach conceptualization, on the line between an empowered, knowledgeable professional and a conservative one.

SECTION D.
CROSS - CASE PERSPECTIVE

SECTION INTRODUCTION: SUB-QUESTION 4

This section will move from single cases to a cross-context analysis of the phenomenon at study: the possible connection between TPCK-informed design tasks at pre-service education, and student-teachers' PR for technology integration. Still acknowledging the specificities of each case study, in the following paragraphs findings will be described with a primary focus on the phenomenon in its extent across the contexts (Yin, 1994; Stake, 2006).

The research sub-question that this section addresses is the last one (§B-Chp.1), investigating possible shared patterns across case studies, regarding

(a) initial teacher education programmes' strategies for TPCK-informed instructional design tasks (i.e. cross-context analysis of single-case evidence for sub-question 1);

(b) technology related student-teachers' dispositions and modifications through multiple design tasks (i.e. cross-context analysis of single-case data for sub-question 2); and

(c) student-teachers' pedagogical reasoning (PR) characterization and modification through multiple design tasks (i.e. cross-context analysis of single-case data for sub-question 3).

Considering these premises, the section structure will follow the focuses of research sub-questions 1-3 (§B- Chp.1) respectively on design task procedures, dispositions toward technology integration, and pedagogical reasoning instances. The data presented will be a meta-analysis of the single cases' ones, seeking for commonalities among contexts (design tasks and procedures; PR), or will be emerging from specific analyses carried out on the three populations as a whole (dispositions). As the end of the section, then, a possible answer to the main research question will be advanced, as arising from said cross-case analysis of the *quintain* (Stake, 2006) and possibly enriched by single-case instances.

CHAPTER 1.
DIFFERENT SHADES OF COMMON: TPCK-INFORMED INSTRUCTIONAL DESIGN PROCEDURES AND PR

As already mentioned in the single case analyses (§Section C), considering how the instructional design tasks were characterized in terms of technology integration and pedagogical reasoning theories was a crucial component in answering the main research question. While still recognizing single cases' unique features, the paragraphs below will try to account for possible common patterns among the three initial teacher education programmes' strategies for TPCK-informed design tasks, to provide a more robust explanation of the event itself (Yin, 1994).

First of all, the relation between design procedures and technology integration theories. As the reader might recall from the previous section, each case referred broadly to the TP(A)CK framework for teacher knowledge, which some authors in academia regard as language for discussing technology integration in instruction (see Hammond & Manfra, 2009; §A-Chp.1). Whereas some procedures were more clearly focused on either TP(A)CK's integrative (IT case) or transformative (CY case) perspectives, all three design procedures were based on the assumption of inter-connecting pedagogy, content, and technology in an efficient way to promote learning. Great importance was given to technological pedagogical affordances (Angeli & Valanides, 2018; §A – Chp.3), especially when in coherence with teachers' approaches (IT case) and to the service of learners' content-related difficulties (CY case), for a meaningful learning experience (NL case).

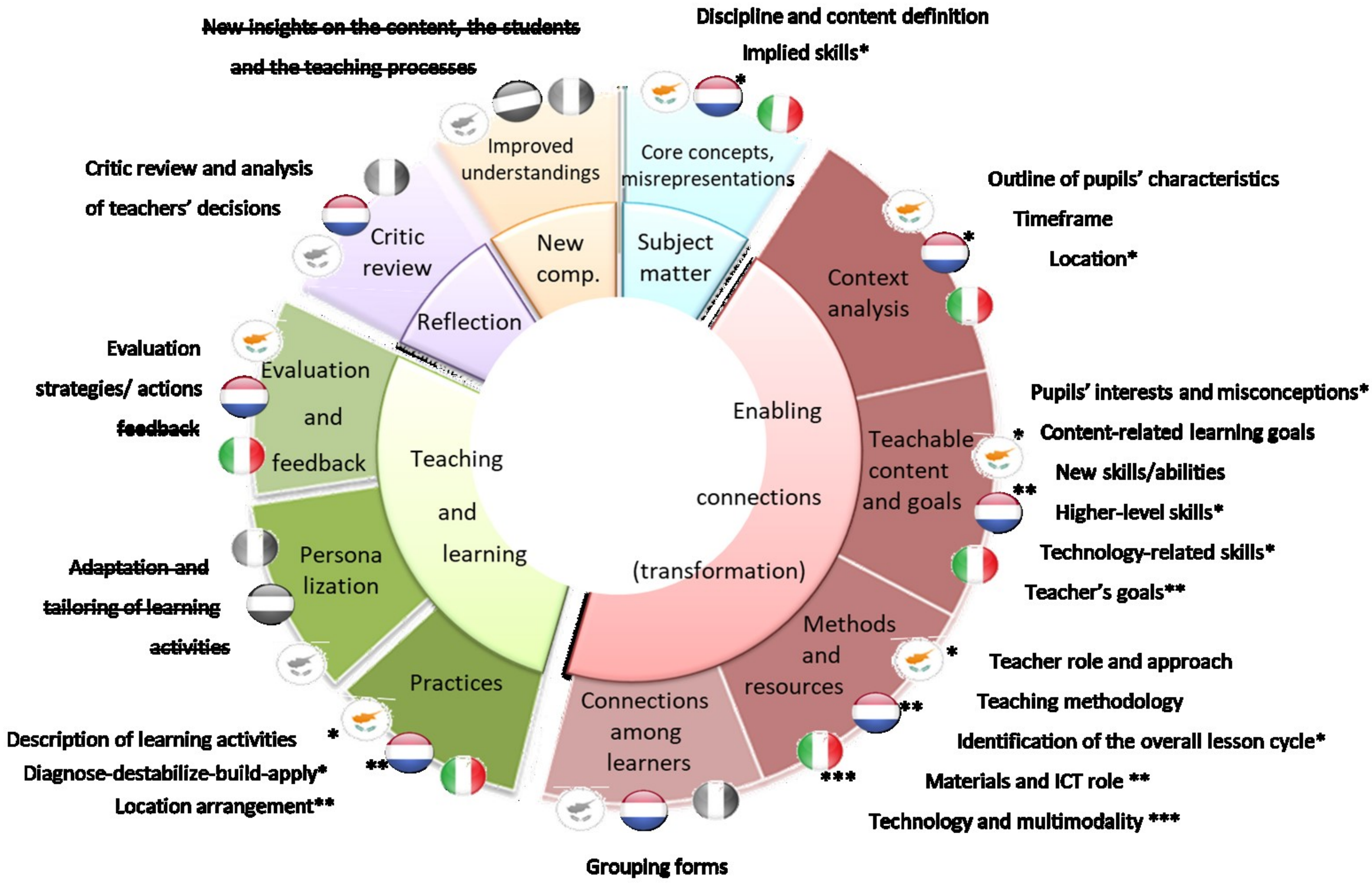
In the case unit selection process (§Section B) it was used as a criterion the context's attention for technology integration in teaching and learning and, considering the broad academic use of the TP(A)CK framework as a reference in that sense (§Section A), these findings are not very surprising. Nevertheless, the common reference to the TP(A)CK framework serves us to two purposes: on one hand it helps with the research the question as TPCK-informed design tasks were indeed being investigated, and on the other it creates further comparison ground among the three contexts.

The three instructional design procedures seem also to share some similar characteristics when it comes to pedagogical reasoning (PR) models references. Still considering the adapted PR model already described (§B – Chp.3.1) as lens for data analysis, it can be noticed that not only the single procedures' structures overlap with many reasoning dimensions by themselves (§Section C), but they also share these overlaps with each other (see Picture 1. on the next page).

Picture 1.1 shows, coloured, the cases where the single PR dimension was clearly detectable in the contextual design procedure, and in grey the ones where it was not. Only common aspects are reported, and an asterisk marks wherever the single case's procedure differed greatly from the others (e.g. adding specific items). Going down to the specifics, it can be seen how the particular dimensions were supposedly tackled by the procedures:

- *Comprehension of subject matter:* as identification of the broad discipline boundaries and core concepts, it appeared in several items across the three procedures. The Dutch one also observed the discipline in terms of implied skills, along with its synthetic understanding;
- *Enabling connections (transformation):* as a process of conversion of expert knowledge into teachable content, it includes:
    - Analysis of the contextual characteristics aimed to adapt ones' teaching to pupils'[1] specific needs. The three procedures asked student-teachers to outline the educational context in which to set their design, although they delved differently with the importance given to the identification of pupils' abilities, gender, language, motivations and expectations (Shulman, 1987). Just as a reminder, the Cypriot and Italian ones mentioned specifically pupils' demographics, the Dutch one adding the attention for the physical environment where the learning process was to take place[2]. The timeframe for the learning unit was also part of the contextual analysis as it was usually given or suggested to the student-teachers.

[1] Pupil refers to the students whom the instructional design product is ideally addressed to.
[2] For further details on the single procedures, please see §Section C.



Picture 1.1 PR adapted model in multiple design procedures - CY, NL, IT.

- <u>Identification of how teachable content looks like</u> in pursuing a merge between expert subject matter knowledge (of the teacher) and situated needs (of the learners). While all three procedures considered the identification of suitable educational purposes and goals (Shulman, 1987), both content- and skill-related, some contextual differences can be detected. The Cypriot procedure stressed the importance of moving from pupils' interests and misconceptions, towards the improvement of higher-level (and technological) skills. Furthermore, the Dutch procedure mentioned teachers' goals along with learners' ones, widening the perspective.

- <u>Selection of adequate resources and teaching methods</u> to engage pupils' previous knowledge and build a new one (Starkey, 2010). Several approaches to this reasoning step can be detected, within the procedures. While the identification of pedagogically powerful and yet adaptive teaching methods and models (Shulman, 1987) was shared by the three contexts, it was stressed mainly by the Italian procedure (§Section C). This one also required the selection of technological resources to account for the multimodality they would enable, while the Dutch procedure stressed their overall role within the learning experience. In the Cypriot case technological resources appear implied and transversal to the choice of teaching methods, which in turn had to follow a fixed structure for building pupils' knowledge (see *teaching and learning* later).

- <u>Endorsement of connections among groups and individuals</u> to develop new knowledge (Starkey, 2010). This step was clearly detectable only in the Dutch procedure, although it is to highlight that all three possibly suggested to create opportunities for pupils to negotiate and socialize their naïve/new knowledge, through other contextual means (§Section C).

- *Teaching and learning*, as the most visible part of the decisional process, including:

  - <u>Classroom-based practices</u> (Shulman, 1987). Every procedure mentioned strategies for classroom organization and management, learning events/activities, content exploration, teacher-student interactions, and so on. Once again, different perspective on these practices emerge from the three procedures: on the one hand a clearer intent to tackle the pupils' knowledge building process (CY case), on the other a more general understanding on class-based events (IT, NL cases). Furthermore, the Dutch one stressed the importance of arranging the physical environment according to the pedagogical means and contents to be implemented.

- Personalization of practices, in the tailoring of the approaches, materials and methods to address the content considering unexpected/emerging situated needs (Shulman, 1987; Starkey, 2010). While teaching flexibility was possibly suggested in every context (see §Section C), it was not clearly detectable in any design procedure.

- Assessment and feedback practices. Teacher checking for pupils' (mis-) understanding, possibly acknowledging implications of both content goals at stake and learning processes enacted (Shulman, 1987), was common to all design procedures. Interestingly, though, none of them explicitly mentioned any feedback strategy.

- *Reflection*, as critic review and analysis of teacher's decisions (Starkey, 2010). A clear reference to this dimension was detectable only in the Dutch procedure (through prompts reminding of self-regulated learning approaches – see Kramarski & Michalski, 2015), although the Cypriot and Italian one might have suggested it through other contextual means (see §Section C).

- *New comprehension about students, teaching processes and content* (Starkey, 2010) was not clearly referred to by any design procedure, although other contextual means to support it cannot be excluded (see §Section C).

These findings are interesting as they help understanding possible intended connections between the implemented design tasks and guidelines, and the theoretical perspectives on pedagogical reasoning for technology integration. Considering the commonalities in the three design task procedures about possible matches to most PR dimensions, similar influences on the participants' elicited reasoning could be expected about, e.g., *subject matter comprehension, enabling connections/transformation*, and partly about *teaching and learning* (i.e. classroom-based practices, and evaluation strategies). Similarly, great differences in reasoning mentions could be foreseen linked to design tasks, with regards to decisions about *connections among learners, personalization,* and *reflection.*

As already described in the single cases, though, the task guidelines-reasoning connection was not so straightforward (§Section C).

To better understand the possible different task outcomes on reasoning engagement, interview data were analysed. There, it was observed how the participants in the three contexts could identify in their procedure the theoretical foundations for technology integration (CY and NL cases), although not always understanding thoroughly the practical implications (IT case). Most of the student-teachers would even discuss their design products using the same theoretical-based lexis given from their procedure. Nevertheless, some differences can be highlighted, for example while the participants in CY and IT would use the academic lexis to talk about the decisional structure of their design process, NL interviewees would use the studied theories to sustain their overall professional knowledge but not to inform the specific reasoning steps.

As the reader might recall (§Section B), most participants in the three contexts stated this was their first university course dealing with technology integration, and to no surprise most of them found the design task and the germane procedure to be new in the requirements, posing at first some difficulties in the task completion. However, most to all student-teachers used their given procedure to complete the design task in Cyprus and Italy, whereas just a little minority of Dutch participants did so. This last group of participants was also the one with the highest performance orientation (although that was not missing completely in the other contexts) and the one least attributing worth to the given guidelines for effective technology-integrated design. To the contrary, Cypriot and Italian participants deemed their guidelines somewhat to very valid instruments to design technology-enhanced lessons, and stated they would use them again in their future profession.

Along with the task procedures' structure and theoretical bases, the student-teachers' perception and actual use in the three contexts helps understand the extent to which the participants' reasoning might indeed be considered linked to said procedures and tasks (as per main research question).

CHAPTER 2.
DIFFERENT CONTEXTS, SIMILAR DISPOSITIONS FOR TECHNOLOGY INTEGRATION: STUDENT-TEACHERS' PROFILES ACROSS CASES

As already highlighted in the theoretical section of this dissertation (§A-Chp.2), teachers' dispositions influence greatly the decisions whether to integrate technologies or not (Forkosh-Baruch, 2018; Knezek & Christensen, 2018; Scherer et al., 2018; Tondeur et al., 2019; Voogt et al., 2012; Yeh et al., 2017). While pedagogical-technological beliefs and attitudes are not the main focus of the present research, they were investigated to better understand participants' elicited reasoning for technology-enhanced design, in consideration of dispositions' strong action as filters and enablers of practices (Ertmer, 2005; Ottenbreit-Leftwich et al., 2018; Niederhauser & Lindstrom, 2018).

This chapter will move past the single cases' unique features (described in §Section C) to describe student-teachers' dispositional patterns shared by the three contexts, so to provide a more robust explanation of the whole event itself (Yin, 1994). First, the text will go deeper into the quantitative analysis of the pre-/post questionnaires on student-teachers' dispositions toward technology integration, describing emerging common profiles also with the support of the participants' words (§Chp.2.1). Then, the data emerging mainly from the focused interviews will be presented to get a further insight on the pedagogical beliefs shared by the three groups of participants (§Chp.2.2).

2.1 PROFILES OF DISPOSITIONS FOR TECHNOLOGY INTEGRATION

2.1.1 At the beginning of the academic journey for technology integration

Beside using questionnaire data to observe case-specific characteristics, common patterns in student-teachers' answers about technology-related dispositions could be identified, across the three contexts.

A Two-Step Clustering analysis was carried out on pre-questionnaire data in SPSS to attribute respondents to clusters, according to the similarity of answering patterns on continuous variables (our factors) and using the distance measure as similarity criterion (IBM, n. d.). Questionnaire's factors used to identify clusters of participants were:

- *Emotive signposts* (α= .90), further specified in:
    - *Emotive barriers* (α= .87) related to stress, frustration and difficulty in the approach to educational technologies; and
    - *Emotive enablers* (α= .82) related to comfort, ease and likelihood to include technologies in everyday practices.
- *ICT impact* on teaching and learning (α= .90), concerning the perception of technologies' influence on teaching and learning processes, as well as their worth; and
- *Lack of worth* of ICT (α= .70), related to the assumption of technologies' inconsequentiality if not even negative impact on teaching and learning processes.
- *Self-efficacy* (α= .93) regarding the self-assessment of the practical capability to integrate technologies for educational purposes.
- *TPCK in teaching practice* (α= .95) dealing with content-based, pedagogically – oriented, technologically-integrated practices;
- *TPCK awareness* (α= .82), concerning the approach to knowing ICTs for content-related educational purposes.

Such Two-Step Cluster analysis was carried out on the three groups of pre-questionnaire participants altogether (N=288), regardless of their case-belonging, so to make the statistics more robust[1]. Four student-teachers' profiles differently grounded in the three cases were identified, in relation to the pre-questionnaire. As per Figure 2.1, the most numerous

[1] This, particularly in reference to the very low numbered Dutch population.

cluster was the third, which was renamed Chara[2], and the least one was the first, renamed Adam.

As for the actual properties (or functions) of respondents' answers determining the clustering attribution in the pre-questionnaire, through a discriminant function analysis it could be observed that 91% of the participants was clustered correctly in this phase. Three functions were identified as discriminant in ascribing the respondents to the clusters (Table 2.1; Table 2.2):

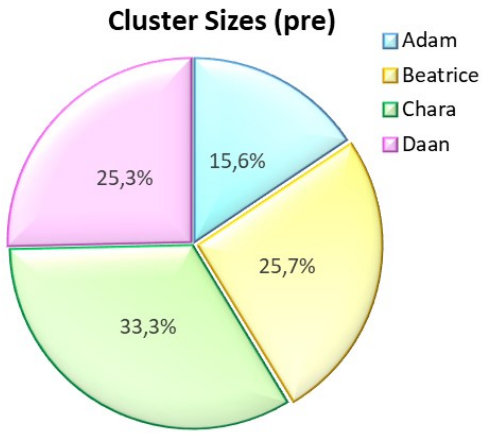


Figure 2.1 Cross-context clusters of respondents to the pre-questionnaire on dispositions towards ICT integration (N 288).

Table 2.1 Identified functions discriminating clusters (pre-questionnaire).

Functions at Group Centroids			
Cluster Number (PRE)	Function		
	1	2	3
1	-3,259	,236	-,256
2	-,307	-1,308	,122
3	-,012	,871	,180
4	2,336	,035	-,203
Unstandardized canonical discriminant functions evaluated at group means			

Table 2.2 Factors implied in the functions discriminating clusters (pre-questionnaire).

Standardized Canonical Discriminant Function Coefficients			
	Function		
	1	2	3
Emotive signposts	,408	-,041	,367
Impact of ICT	,241	-,201	-,297
Lack of worth	-,169	,590	,422
Self-efficacy	,337	,532	,168
TPCK in practice	,526	,263	-,621
TPCK awareness	,386	-,335	,503

1. One relying mostly on *emotive signposts* and *TPCK in practice*'s answers, separating clearly cluster 1 (Adam) from 4 (Daan);
2. A second one relying mostly on the perceptions of *lack of worth* and *self-efficacy*, further separating respondents in clusters 2 (Beatrice) and 3 (Chara); and
3. A third one relying on *TPCK awareness*, with contribution of perceptions of *lack of worth,* to eventually polish the whole categorization, albeit not having a strong influence overall.

The factor *impact of ICT,* while contributing in the clustering strategy, was not determinant in any function.

[2] Every name assigned to the clusters is a fictional name and any resemblance to real events and/or real persons is purely coincidental.

Further analyses confirmed that the four profiles are indeed significantly different from each other (p <.05) with meaningful effect sizes (*d* from .4 to 2). Most interestingly, though, was to see how these profiles would gather respondents in all three contexts, albeit at various rates (see Figure 2.2):

- Adam (cluster 1) virtually represents 45 student-teachers, distributed mainly between Cyprus (n =9) and Italy (n =36);
- Beatrice (cluster 2) possibly represents 74 student-teachers, among which 9 were found in Cyprus, 62 in Italy and 3 in The Netherlands;
- Chara (cluster 3) stands for 96 student-teachers, of whom 52 are Cypriot, 42 Italian, and 2 Dutch;
- Daan (cluster 4) virtually represents 73 student-teachers, gathering most of the Dutch respondents (n = 6), but being ground also in Cyprus (n = 43) and Italy (n = 24).

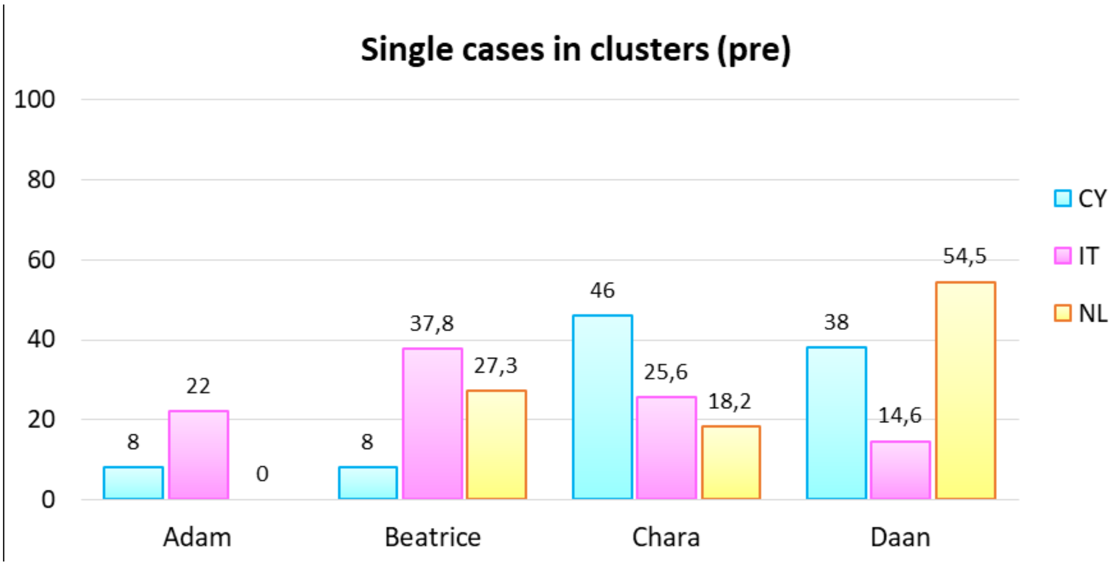


Figure 2.2 Single cases' distribution in clusters - pre-questionnaire.

It was then observed how these four types of student-teachers would ideally answer the pre-questionnaire on dispositions towards ICT integration (Figure 2.3). Although Beatrice, Chara and Daan's characteristics were already hinted at when analysing the cases in which they gather relatively the most respondents (respectively Italy, Cyprus and The Netherlands), here some further detail about the four of them will be provided, especially in comparison with each other. Moreover, thanks to the instrument of focused interviews, it will be possible to have additional insight on these ideal profiles through the words of actual student-teachers to them affiliated. Considering the first-round interviews carried out, it appeared that: 5 Adam (all Italian), 9 Beatrice (2 Cypriot, 4 Italian, 3 Dutch), 9 Chara (6 Cypriot, 1 Italian, 2 Dutch), and 13 Daan (4 Cypriot, 2 Italian, 7 Dutch) were interviewed across the three contexts[3].

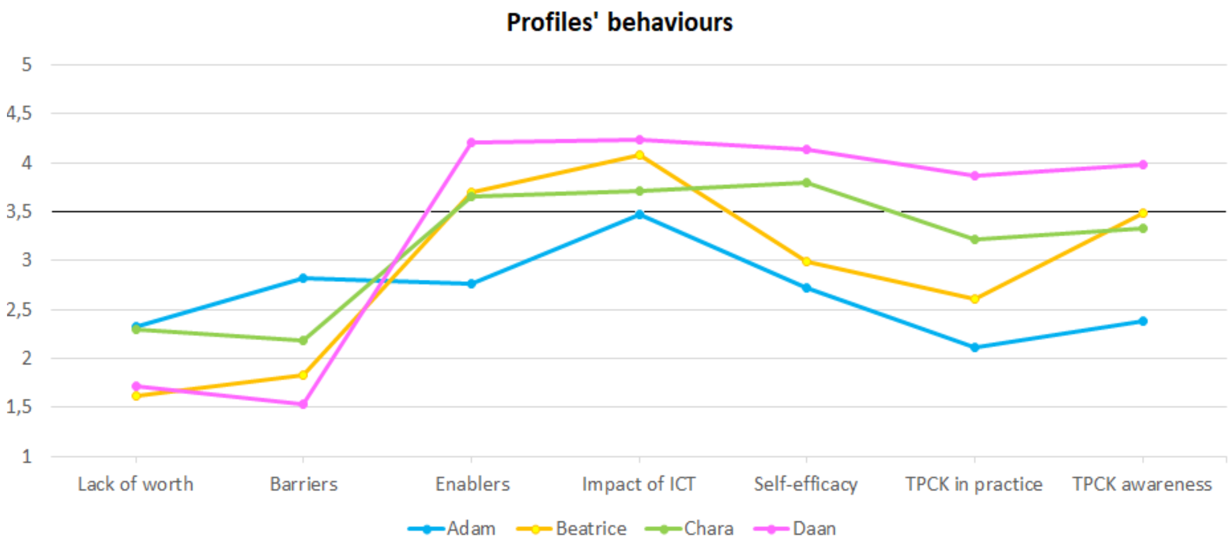


Figure 2.3 Clusters' dispositions towards ICT integration - pre-questionnaire

[3] Total number of first-round interviewees selected for the cross-analysis: 36. As the reader might recall (§B-Chp.3.3), among the volunteers for the first- (47) and second- (40) round of interviews, only 12 per case were selected, randomly, to carry out the cross-case analysis. The matching of pre-interview and pre-questionnaire's profiles was executed after this selection.

Adam – the disengaged

Table 2.3 Adam's dispositional factors, mean scores.

ADAM (N= 45)	Mean	Std. Deviation	Sig.[a]	Cohen's *d*[a]
Emotive signposts	3,0	,59	.000	≥ 1.7
Enablers	2,8	,58	.000	≥ 1.6
Barriers	2,8	,75	.000	≥ 1.2
Impact of ICT	3,5	,67	≤.01	≥ .5
Lack of worth	2,3	,79	.000 b	≥ 1.0 b
Self-efficacy	2,7	,79	.000 b	≥ 1.9 b
TPCK in practice	2,1	,59	.000	≥ .8
TPCK awareness	2,4	,56	.000	≥ 2.0

a. These measures refer to the statistical significance and size effect of this profile's distance from others. As there were overall four different profiles, if manifold, the bigger (for significance) and smaller (for Cohen's d) values are displayed. As per §B – Chp.3.4, Cohen's d threshold was at .4 (Cohen, 1988).
b. Significance found only in relation to two out of three other profiles. Every profile scored significantly different at least from other two per factor.

Adam (Table 2.3; Figure 2.3) has almost neutral *emotive signposts* ($\bar{x}$= 3.0) with a tie in *barriers* and *enablers* at $\bar{x}$= 2.8, which might denote an overall indifference to the matter of technology integration, figuring unique among the profiles. Similarly, he is the one attributing least possible positive *impact of ICT* use to learning ($\bar{x}$= 3.5) while reporting a perception of *lack of worth* of ICT in education at $\bar{x}$= 2.3. Whereas this negative judgment is still below the middle of the score, it is interesting because Adam figures extreme in his answers, compared to the other profiles. His *self-efficacy* is just below average ($\bar{x}$= 2.7), the least confident among the four clusters, as he is when it comes to assessing his capability to identify and practically enact TPCK (*TPCK awareness* and *TPCK in practice* respectively at $\bar{x}$= 2.4 and $\bar{x}$= 2.1).

In the words of the Adam interviewed, it is possible to hear his concerns related to school equipment (e.g. "in real life we don't have in class so many pc" – IT7a), to pedagogical considerations on learning (e.g. "children need to use their hands to learn [not technology]" – IT12a) or even to health issues (e.g. "when you're on a screen all the time is bad for your eyes" – IT10a). While perceiving some kind of potentialities (e.g. "maybe you're not so good in tell a story and so you can use a video because there is someone that can speak [i.e. tell the story] in the right way" – IT10a), his precarious self-efficacy as a teacher strongly relies on personal experiences and practice (e.g. "[I can try but] we didn't have experience and they didn't really teach us how to do in actual practice" – IT1a), with all its possible consequences. Finally, interviewed Adam(s) mentioned being doubtful about their TPCK capabilities (e.g. "I think I don't have the knowledge, first of all, to do that [i.e. integrate technologies]" – IT12a).

All in all, Adam represents a very sceptical group of student-teachers entering a university course dealing with technology integration in education, and he could be the most difficult to engage due a lack of interest, both emotive and professional.

Beatrice – the idealist

Table 2.4 Beatrice's dispositional factors, mean scores.

BEATRICE (N= 74)	Mean	Std. Deviation	Sig.[a]	Cohen's d[a]
Emotive signposts	3,9	,55	≤ .016	≥ .5
Enablers	3,7	,58	.000[b]	≥ .6[b]
Barriers	1,8	,65	.000	≥ .5
Impact of ICT	4,1	,37	.000[b]	≥ 1.0[b]
Lack of worth	1,6	,36	.000[b]	≥ 1.3[b]
Self-efficacy	3,0	,67	.000[b]	≥ 1.5[b]
TPCK in practice	2,6	,66	.000	≥ .8
TPCK awareness	3,5	,56	.000[b]	≥ .9[b]

a. These measures refer to the statistical significance and size effect of this profile's distance from others. As there were overall four different profiles, if manifold, the bigger (for significance) and smaller (for Cohen's d) values are displayed. As per §B – Chp.3.4, Cohen's d threshold was at .4 (Cohen, 1988)
b. Significance found only in relation to two out of three other profiles. Every profile scored significantly different at least from other two per factor.

Beatrice shows fairly high *emotive signposts* ($\bar{x}$= 3.9 – Table 2.4) which might indicate some sort of engagement in the matter, further explicated by a low stress score (*barriers* $\bar{x}$ = 1.8, among the lowest in the profiles) and a mildly high one on comfort (*enablers* $\bar{x}$= 3.7). She is the least sceptic among the four profiles (see Figure 2.3), attributing *lack of worth* to ICT in education only at $\bar{x}$ = 1.6 out of 5, and being second to highest in perceiving a possible positive *impact of ICT* for learning ($\bar{x}$= 4.1). Her *self-efficacy* scores just on the middle of the scale ($\bar{x}$= 3.0) and she is also quite cautious in self-assessing her capability to *practically* enact *TPCK* ($\bar{x}$= 2.6), although she seems slightly more positive on her overall *TPCK awareness* ($\bar{x}$= 3.5).

In the words of the interviewed Beatrice, it is possible to hear her engagement on the matter (e.g. "if they [i.e. pupils] use books you can only get 2 things, they can't really go further, so with [technologies] you can explore further. Maybe it becomes complicated because there are unreliable sources, but your pupils will get further than just the sources that you gave them [and I think it's important]" – NL9a), also in light of the perceived potentialities (e.g. "every student have a different way to learn so I think it's important to propose different things to do because every student can choose the best way to learn" – IT6a; "they [i.e. technologies] really engage [pupils, because] they can zoom in and they can click for extra information and all that stuff and it really engages them into think [about the topic]" – NL3a). Nevertheless, she would mention some concerns on her practical capabilities when it comes to designing technology-integrated lessons (e.g. "I [don't] know how to incorporate [pupils'] individual needs with technology" – CY9a).

All in all, Beatrice represents a fairly motivated group of student-teachers entering a university course dealing with technology integration in education. Through tasks in which she is actively engaged in designing ICT-enhanced lesson plans she could be empowered in her practical capabilities, enacting more easily the ICT educational impact she already perceives intuitively.

Chara – the executive

Table 2.5 Chara's dispositional factors, mean scores.

CHARA (N= 96)	Mean	Std. Deviation	Sig.[a]	Cohen's d[a]
Emotive signposts	3,7	,33	≤ .016	≥ .5
Enablers	3,6	,38	.000b	≥ 1.0 b
Barriers	2,2	,42	.000	≥ .6
Impact of ICT	3,7	,36	≤ .01	≥ .5
Lack of worth	2,3	,34	.000b	≥ 1.4 b
Self-efficacy	3,8	,45	≤ .001	≥ .8
TPCK in practice	3,2	,52	.000	≥ 1.0
TPCK awareness	3,3	,36	.000b	≥ 1.5b

a. These measures refer to the statistical significance and size effect of this profile's distance from others. As there were overall four different profiles, if manifold, the bigger (for significance) and smaller (for Cohen's d) values are displayed. As per §B – Chp.3.4, Cohen's d threshold was at .4 (Cohen, 1988).
b. Significance found only in relation to two out of three other profiles. Every profile scored significantly different at least from other two per factor.

Chara shows *emotive signposts* ($\bar{x}$=3.7, Table 2.5) slightly on the higher end of the scale, possibly indicating some sort of engagement in the matter. Her mildly low stress score (*barriers* $\bar{x}$ = 2.2) is anyway one of the highest among the four profiles, although her comfort still figures above average (*enablers* $\bar{x}$= 3.6). She is the most sceptic among the four profiles, along with Adam (Figure 2.3), attributing *lack of worth* to ICT in education at $\bar{x}$ = 2.3 out of 5. Differently from Adam, though, Chara seems to fairly recognize positive *impact of ICT* for learning ($\bar{x}$= 3.7). She also seems quite optimist on her *self-efficacy,* rated at $\bar{x}$= 3.8. Finally, she scores on the higher end of the four profiles on her self-assessment of the capability to *practically* enact *TPCK* ($\bar{x}$= 3.2), and being overall *aware* of content-related, pedagogical technologies ($\bar{x}$= 3.8).

In the words of the Chara interviewed, it is possible to hear some stress: "I'm scared to use technology in my [lessons], I don't know why, maybe because I'm not good to use technology" (CY11a); "any advice [i.e. notification] that appears on my computer I'm terrified that it's going to break" (IT5a); "I think maybe about in a few years the teacher is not there to teach anymore [because technology took over]" (NL1a). Nevertheless, she attributes worth to using ICT in education, albeit often relating her reasons to the assumption of pupils as digital natives, as: "I don't think that technology is useful or make the lesson more amazing for the children but […] it's hard for them to be in the chair and listen, listen, listen and technology is something that they have in our day at home so" (CY10a); "they [i.e. pupils] just want to be on a computer or iPad or anything, so that triggers their interest in the first place" (NL11a).

All in all, Chara represents a fairly engaged group of student-teachers entering a university course dealing with technology integration in education. Although she is a bit stressed at the idea of using technologies in everyday school practice, she seems sufficiently motivated and self-confident in doing so. Chara could indicate a group of students inclined not to ask too many questions, maybe more sensitive to contextual and performance expectations to integrate ICT. Capitalizing on her openness to engage with technology integration, she could benefit from tasks in which she is actively engaged in designing technology-integrated lesson plans, to discover deeper worth in these tools for learning.

Daan – the self-sufficient

Table 2.6 Daan's dispositional factors, mean scores.

DAAN (N= 73)	Mean	Std. Deviation	Sig.[a]	Cohen's d[a]
Emotive signposts	4,3	,32	.000	≥ 1.7
Enablers	4,2	,39	.000	≥ .6
Barriers	1,5	,40	≤ .007	≥ .5
Impact of ICT	4,2	,52	.000b	≥ 1.3 b
Lack of worth	1,7	,48	.000b	≥ 1.0 b
Self-efficacy	4,1	,44	≤ .001	≥ .8
TPCK in practice	3,9	,39	.000	≥ 1.4
TPCK awareness	4,0	,54	.000	≥ .9

a. These measures refer to the statistical significance and size effect of this profile's distance from others. As there were overall four different profiles, if manifold, the bigger (for significance) and smaller (for Cohen's d) values are displayed. As per §B – Chp.3.4, Cohen's d threshold was at .4 (Cohen, 1988).
b. Significance found only in relation to two out of three other profiles. Every profile scored significantly different at least from other two per factor.

Daan's *emotive signposts* ($\overline{x}$= 4.3, Table 2.6) are quite positive, possibly indicating a clear engagement in the matter. His stress score (*barriers* $\overline{x}$ = 1.5) and his comfort one (*enablers* $\overline{x}$= 4.2) are respectively the lowest and the highest among the groups (Figure 2.3). Daan has also the highest (among the profiles) perception of positive *impact of ICT* in education ($\overline{x}$ = 4.2), contrasted by a score among the lowest on *lack of worth* of ICT in education ($\overline{x}$ = 1.7). He seems rather confident also in his *self-efficacy* ($\overline{x}$ = 4.1) and in his capability to to identify and practically enact *TPCK* (*TPCK awareness* and *TPCK in practice* respectively $\overline{x}$= 4.0 and $\overline{x}$= 3.9).

In the words of the interviewed Daan(s) it is possible to hear how he is comfortable around technologies (e.g. "I like using technology, I am a person that uses technology every day in my life" – CY1a), identifying many added values to using educational ICTs (e.g. "it could be an instrument to teach better and to let the students learn better and have awareness of the world" – IT4a; "with ICT there are just so many possibilities and like at the same page you can have a link for a video, for a music or for a picture so you can [learn in] many ways" – NL5a). He also feels very self-confident ("I know how to teach [with technologies]" – IT2a; "I think it would be really valuable for me to learn how to convince my colleagues, or how to instruct them on how they can properly use technology in their lessons […] show them the light" – NL8a).

All in all, Daan represents an almost self-sufficient group of student-teachers entering a university course dealing with technology integration in education. Ideally at the opposite extreme from Adam, he is very comfortable around technologies and see their potentialities for education, indicating to be nearly expert already, at the beginning of his academic journey. This group of student-teachers might be very difficult to engage due to such over-perception of mastery.

2.1.2 After multiple academic experiences for technology integration

After multiple experiences with TPCK-informed instructional design and the completion of the germane university course, student-teachers' dispositions toward technology integration were investigated once again. An ANOVA was used to compare pre- and post-questionnaires, to detect any modification in participants' answers (N= 303)[4].

As from Table 2.7, the respondents overall changed their rating meaningfully on four factors: two directly entailing dispositions towards ICT integration (*self-efficacy* and *TPCK in practice*) and two indirectly related (*knowledge of use* and *university support* – see Tondeur et al., 2017, 2019). In general, changes always involved a positive increase in the mean, although the size effect figured small to intermediate. As already described (§Section C), single case studies showed specific modifications with encouraging size effects.

Table 2.7 Differences pre-/post – on the three groups of respondents altogether.

		N	Mean	Std. Deviation	Sig.	Cohen's d.
Knowledge of use of higher order technologies	pre	288	1,6	,56	.000	.6
	post	303	2,0	,69		
University's action to support technology integration	pre	288	3,1	,77	.000	.3
	post	303	3,3	,63		
Self-efficacy	pre	288	3,5	,78	.000	.3
	post	303	3,7	,58		
TPCK in practice	pre	288	3,1	,81	.000	.6
	post	303	3,5	,58		

The overall modification, albeit small, in the perception of university support for technology integration, as well as the more significant variation in the self-assessment of familiarity in the use of higher order (i.e. education oriented) technologies accounts on one hand for the courses' aim to introduce student-teachers to technologies fit for educational uses (§Section C). On the other hand, these findings align with the literature on the great potential of different initial teacher education strategies in fostering the development of technology-integrated professionals (e.g. SQD model - Tondeur et al., 2012, 2016; see also Agyei & Voogt, 2011; Baran & Uygun, 2016).

[4] For the case-specific modifications through time please see §Section C.

Moving to the questionnaire factors more specific to dispositions, a small effect (*d*=.3) for *self-efficacy* was detected, indicating a first step to a more confident approach to actual technology-related behaviours (see also Agyei & Voogt, 2011; Kramarski & Michalski, 2015; Tondeur et al., 2017). Moreover, the very interesting desired effect (Hattie, 2009) on the increased scores of *TPCK in practice* could indicate a promising change in participants' dispositions (and intentions) to integrate (Banas & York, 2014; Smart, 2016; Scherer, Siddiq & Teo, 2015; Tondeur et al., 2017, 2019). Considering that participants' familiarity with educational technologies improved along with the appreciation of the academic support, their self-efficacy and TPCK measures, it could be foreseen an increase in the participants willingness to choose and participate in technology-integrated activities (Abbitt, 2011; Ertmer & Ottenbreit-Leftwich, 2010; Kavanoz, Yuksel & Ozcan, 2015; Tondeur et al., 2016b, 2017, 2019).

Moreover, it was sought to see if the pre-questionnaire based clusters were still valid in the post-questionnaire's answers. Trying to force the same discriminant functions of the pre-clustering strategy on the post-data resulted in an accuracy of the 19,8%. This means, as suggested by the overall modifications abovementioned, that the respondents at the end of their academic journey for technology integration responded according to different criteria than before[5]. As observable in Table 2.8, the respondents previously rightfully affiliated to Adam and Daan's profiles now are no more relatable to those but shifted to some other profile. Similarly, some of the previously rightfully identified Beatrice(s) and Chara(s) changed profile affiliation in the post-questionnaire. This might suggest a degree of success by the university courses in engaging the even the most indifferent (Adam) and over-confident (Daan) attendees towards a more moderate approach. Forcing the previous functions to post-questionnaire data revealed indeed a shift in the participants' affiliation to profiles, but from Table 2.8 it is not yet possible to see the new distribution and characterization of respondents in the post-questionnaire, also considering the new criteria underpinning the new clustering strategy.

Table 2.8 Shift in cluster composition pre/post.

Respondents correctly attributed to the same clusters (according to pre-questionnaire based functions)		
Cluster	Pre-quest. participants	Post-quest. participants
1 – Adam	39	0
2 – Beatrice	60	13
3 – Chara	93	47
4 – Daan	70	0

[5] This is supported also by the different multi-dimensional scaling findings described case-wise in §Section C.

A new Two-Step Clustering analysis and discriminant function analysis round was carried out only on the post-questionnaire data, to better understand the characteristics of the new clustering of participants. The questionnaire's factors implied were, once more: *emotive signposts* (*emotive barriers* and *emotive enablers*), *ICT impact on teaching and learning, lack of worth of ICT*, *self-efficacy, TPCK in teaching practice* and *TPCK awareness.*

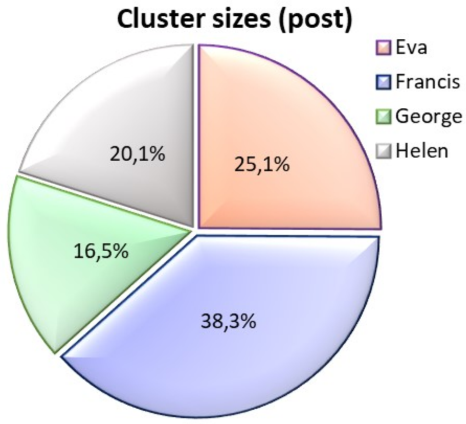


Figure 2.4 Cross-context clusters of respondents to the post-questionnaire on dispositions towards ICT integration (N 303).

Once again, four clusters emerged (Figure 2.4), significantly different from each other ($p.<.05$, $.4 \leq d \leq 3$) and with the original clusters ($p.<.05$, $.4 \leq d \leq 1.5$). Nevertheless, they still gathered respondents in all three contexts, albeit at various rates (see Figure 2.5) [6]:

- Erin (cluster 5) virtually represents 76 student-teachers, distributed mainly between Cyprus (n =24) and Italy (n =50), with a minority of Dutch (n = 2);
- Francis (cluster 6) possibly represents 116 student-teachers, among which 33 would be found in Cyprus, 75 in Italy and 8 in The Netherlands;
- George (cluster 7) stands for 50 student-teachers, of whom 27 are Cypriot, 22 Italian, and 1 Dutch;
- Helen (cluster 8) virtually represents 61 student-teachers, gathering mainly respondents from Italy (n= 52) and Cyprus (n = 9).

[6] The following names are fictional and any resemblance to real events and/or real persons is purely coincidental.

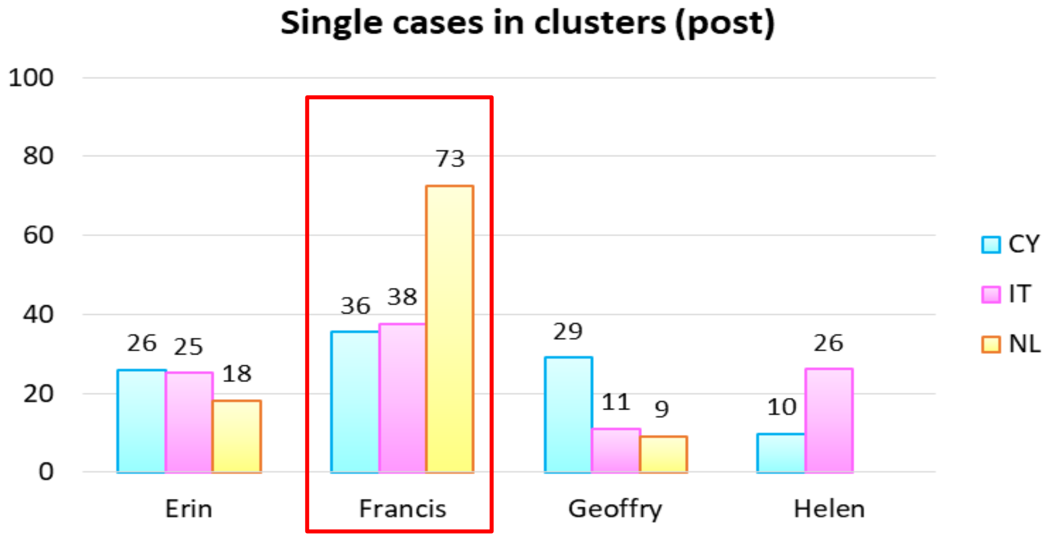


Figure 2.5 Single cases' distribution in clusters - post-questionnaire

A very interesting aspect of the clustering characterization emerging from post-questionnaire data is that the most numerous profile for each case-study is the same: Francis (Figure 2.5; Table 2.9). Considering the affiliation of post-questionnaires' respondents to the various clusters and the second-round interviewees selected, it appeared that 4 Cypriot, 5 Italian, and 7 Dutch interviewees eventually completed their final questionnaire as a Francis would[7]. Thanks to these data, it will be possible to have some further insight on Francis' ideal profile through the words of actual student-teachers to her affiliated[8].

[7] Total number of second-round interviewees: 36. As the reader might recall (§B- Chp.3.3), among the volunteers for the first- (47) and second- (40) round of interviews, only 12 per case were selected, randomly, to carry out the cross-case analysis. The matching of post-interview and post-questionnaire's answers was executed after this selection.

[8] While every new profile's characterization would be interesting, our purpose in this part is to account for cross-context similarities and Francis figures as a shared typical student at the end of her academic course for technology integration. For this reason, only her profile will be here further detailed.

Francis – the positive pragmatist

Table 2.9 Francis' dispositional factors, mean scores.

Francis (116)	Mean	Std. deviation	Sig.*	Cohen's *d**
Emotive barriers (stress and avoidance)	2.0	,52	.000	≥.65
Emotive enablers (comfort and openness to use)	3.7	,44	.000	≥.96
Impact of ICTs on teaching and learning	3.9	,31	≤.001	≥.51
Lack of worth of ICTs in education	2.0	,32	.000	≥1.4
Self-efficacy	3.8	,42	≤.001	≥.76
TPCK in teaching practices	3.6	,36	.000	≥1.03
TPCK awareness	3.6	,45	.000	≥1.49

* These measures refer to the statistical significance and size effect of this profile's distance from others. As there were overall four different profiles, if manifold, the bigger (for significance) and smaller (for Cohen's d) values are displayed.

Francis is likely a 17-22 years old student-teacher at the completion of her academic course for technology integration in instructional design. She shows an average appreciation of *university equipment* and *encouraging actions* (mean scores on these areas[9] are 3.3 – 3.6 out of 5 in the Likert scale). She is somehow familiar with *lower order digital applications and software* ($\bar{x}$ =3.2), but not so much with the *higher order* ones more specialized for the educational context ($\bar{x}$= 2.0). She is also very keen on *surfing the internet* to explore web-based technologies ($\bar{x}$=4.7). Francis' dispositions towards ICT integration are distinctive in relation to the original types of student-teachers found (namely Adam, Beatrice, Chara and Daan - see Figure 2.6), accounting for the significant differences suggested by the discriminant function analyses and the overall pre-post ANOVA.

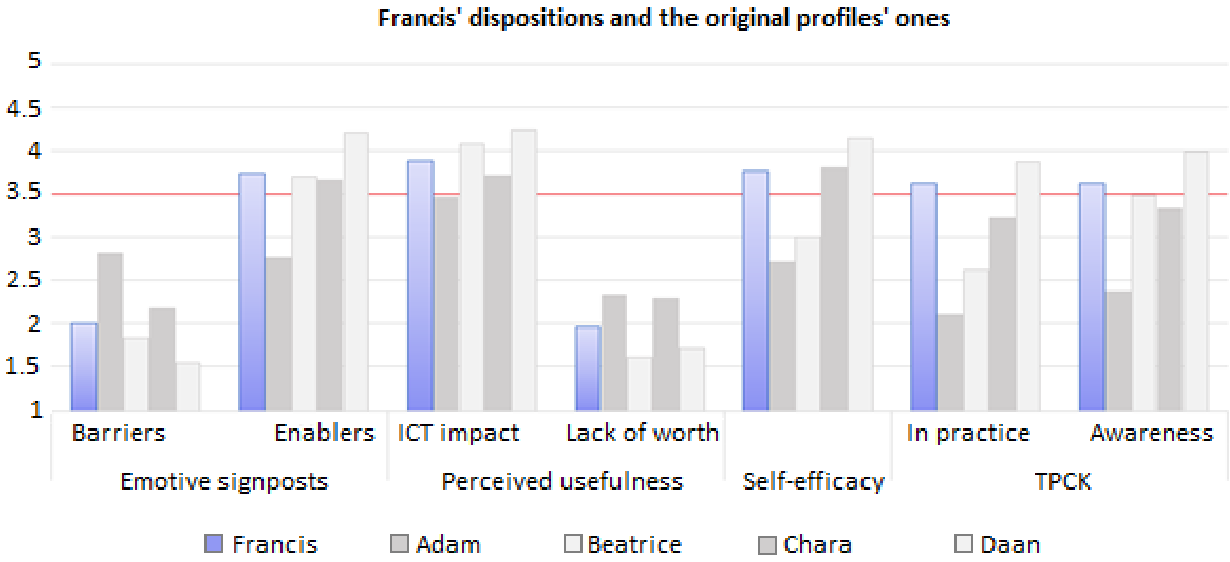


Figure 2.6 Francis and original four profiles' scores for dispositions towards ICT integration

[9] As the reader might recall from §B- Chp.3.4, the questionnaire's factors related to this topic are: *Surrounding encouragement* (α = .79), *University equipment* (α = .83), and *University's active role* (α = .92).

It is to highlight that Francis' scores result most different from profiles like Daan's and Adam (p=.000, *d* ≥.5 on every factor), while not so much from Beatrice[10] and Chara[11]. Once again, this reflect a significant modification in participants' patterns of answers between the pre- and post-questionnaire, especially in relation to the more extreme profiles (i.e. Adam and Daan) which now lost ground to a more moderate one (Francis).

As for Figure 2.6 and Table 2.9, Francis' *emotive signposts* ($\overline{x}$= 3.9) are quite positive, possibly indicating a strong engagement in the matter. Her stress scores (*barriers* $\overline{x}$ = 2.0) are higher than Chara and Daan's, but still quite low on the scale (e.g. "UTellStory is a little difficult for me because it's a webpage, it's not on my laptop [to] download so for me it's difficult to [remember] passwords and it makes me a little stressed but it was ok" – CY2b). Her comfort (*enablers* $\overline{x}$= 3.7) is on the higher end of the scale, albeit not reaching the height of Daan's positivity (e.g. "I feel quite comfortable now around a computer [...] I'm not scared to use them" – IT4b). Francis also has a fairly good perception of the possible *impact of ICT* for teaching and learning ($\overline{x}$ = 3.9; e.g. "if you did this [course] you're going to be more critical about the things that [technology] can do and about the things that are educational in sense of what can students learn from it, instead of is it fun or is it fun to use?" – NL11b), contrasted by a score on *lack of worth* of ICT ($\overline{x}$ = 2.0) which, although still low, remind of old concerns, for example "[technology is nice but] we don't have for now the equipment so" (CY8b); "I think technologies are not able to do what a work made with hands can do, for the understanding" (IT4b). She seems rather *self-confident* ($\overline{x}$ = 3.8), second only to the self-sufficient Daan (e.g. "I was always into technologies so I'm even more confident now" – CY3b; "there was always this kind of wall in front of me when I have to use something new [i.e. technologies] but I think this [course] helped me get through that, that I would actually like [say] 'ok this is new I'm going to try it'" – NL11b). Finally, she assesses her capability to to identify and practically enact TPCK (*TPCK awareness* and *TPCK in practice* both at $\overline{x}$= 3.6) on a quite positive note, higher than three out of four original types of student-teachers (e.g. "I think technology it's one of the most important tools in education, but you have to know how to use it, you can't just apply everything everywhere and say that you used technology while you're teaching. You have to know what tool it's the right one for the subject you're doing to do, for the specific topic that you chose and the class" – CY11b; "[technologies] make kids have fun, which is a way to keep motivation, a way to manage the classroom in an active, positive way" –

[10] Francis is different from Beatrice only on factors as *lack of worth* p. <.0.5, d.=1; *self-efficacy p.* <.0.5, d. =1.5; and *TPCK in practice p.* <.0.5, d.=2.1.
[11] Francis is different from Chara only on factors as *lack of worth* p. <.0.5, d.=1; *TPCK in practice p.* <.05, d. =.9; and *TPCK awareness p.* <.05, d.=.7.

IT6b; "if the work can be done the same way with or without [technology] then I would not use technology or instead if I think that it could be good for the child [I would use it]" – IT7b).

All in all, Francis represents a fairly motivated group of student-teachers at the end of their university course dealing with technology integration in education. Through tasks in which she actively engaged in designing ICT-enhanced lesson plans she possibly strengthened her self-esteem and confidence in being able to recognize and applicate meaningful technology integration. She is not blind to the issues that the use of technology might bring along, and manifests some personal and professional concerns about it, although the perception of ICT's potentialities for learning will likely support her overcoming the challenges (Ertmer & Ottenbreit-Leftwich, 2010; Joo et al., 2014, 2018; Ottenbreit-Leftwich et al., 2018).

The overall ANOVA and the specific clusters' modification through time would suggest a possible impact of the attended academic courses in fostering an open but realistic approach to technology integration (Tondeur et al., 2016b, 2017, 2019). The courses managed to involve the disengaged Adam(s) as well as the self-sufficient Daan(s), possibly supporting the maturation of Francis' positive and resilient dispositions, anticipators of successful technology integration behaviours (Abbitt, 2011; Banas & York, 2014; Ertmer & Ottenbreit-Leftwich, 2010; Smart, 2016; Voogt et al., 2016). It is indeed interesting that the three case studies would eventually gather around a common profile for student-teachers' dispositions toward technology integration. Further research would be advised to better understand the implications of such phenomenon (§Section E), especially in relation to the "reality shock" usually experienced by pre-service teachers in the transition to actual professional practice (Tondeur et al., 2016a, b).

2.2 Trends of dispositions for teaching and learning in the technological era

Pedagogical beliefs on teaching and learning are found in the literature as strongly related to technology integration practices, whether in a more traditional perspective on teaching and learning (see Chai, 2010; Ertmer et al., 2012; Kim et al, 2013), or in a more learner-centred/constructivist one (Agyei & Voogt, 2011; Ertmer & Ottenbreit-Leftwich, 2010; Kim, 2016). In the three case studies' reports (§Section C) the peculiar configuration of participants' pedagogical beliefs related to technology integration has already been discussed. In the following paragraphs the commonalities among these configurations will be introduced, at the beginning (Figure 2.7) and at the end (Figure 2.8) of the observed academic courses. ENA will be used for data visualization and, to ease the reading, the three overlapping networks are presented juxtaposed.

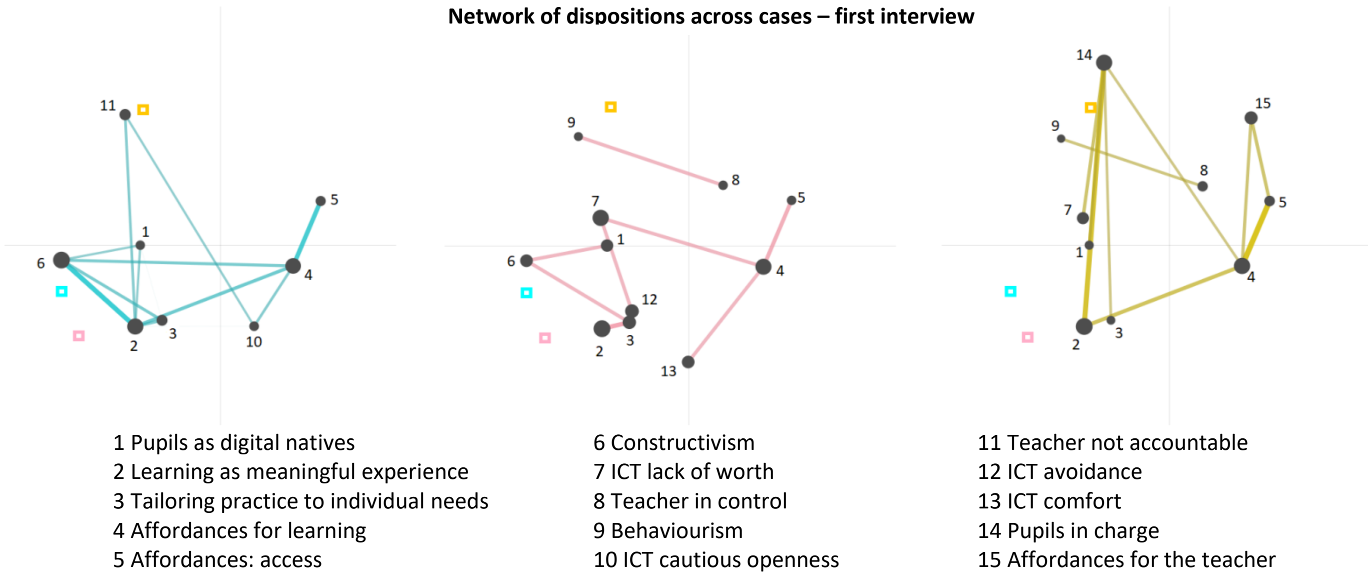
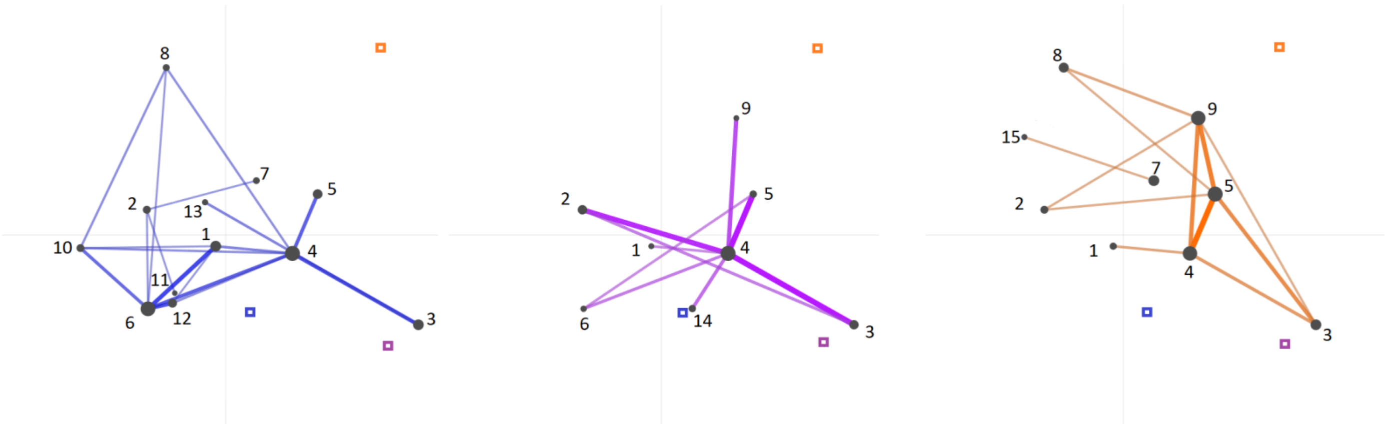


Figure 2.7 Network of dispositions across cases- first round of interviews.

At the beginning of their academic course for technology integration (Figure 2.7), participants in the three contexts shared a common strive towards the creation of *meaningful learning* (2) experiences for their pupils, valuing *tailoring* (3) approaches and technological *affordances* to the service of *learning* and learners (4). In Cyprus and Italy these considerations are accompanied by a *constructivist* (6) perspective on teaching and learning which, along with the already mentioned value attributed to enabling *meaningful learning* (2) experiences, figures as central in their pedagogical beliefs discourse. In the Dutch participants' words, the central role attributed to the *pupils* (14) in defining the learning experience seems highly valued, but there is an ambivalence in the consideration of technologies' *affordances* to the main *benefit of the teacher* (15). The emerging ideal teacher is differently pictured by the three initial discourses, figuring as *not* really *accountable* (11) in Cyprus and more *in control* in Italy and The Netherlands.

Network of dispositions across cases – second interview



1 Reflective teacher
2 ICT lack of worth
3 ICT reasoned openness
4 Affordances for learning
5 Affordances: access
6 Learning as meaningful experience
7 Teacher in control
8 Pupils in charge
9 Affordances for the teacher
10 Constructivism
11 ICT avoidance
12 Tailoring practice to individual needs
13 ICT openness
14 ICT cautious openness
15 Behaviourism

Figure 2.8 Network of dispositions across cases- second round of interviews.

As anticipated in the single cases' reports section (§Section C), student-teachers' dispositions changed through the course and the two design cycles within (see Figure 2.8). Particularly relevant seems the modification in the ideal of teacher, who became more empowered (*in control* - 7) in Cyprus and The Netherlands, the former now considering also *pupils*' choices *central* (8) to the learning experience, while the latter still contemplating also a *behaviourist* perspective on teaching and learning (15)[12]. Italian student-teachers moved away from the consideration of a controlling teacher towards a more *reflective* one (1), a conception shared by the three contexts, although with different specificities: while in Italy and The Netherlands this ideal is connected with the identification of *affordances for learning* (4), in Cyprus it relates mainly with the stance of making the learning *meaningful* (6) for the pupils and is closer to the overall centroid of discussion.

Overall, it is noticeable the shared interest for *learning-oriented affordances* (4) linked to a *reasoned openness to ICT* integration (3) based on content-related, pedagogical and technological assumptions. Such increased interest for a learning-oriented, open approach

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[12] As per §C-Chp.3.2, even if the Dutch participants still talk about valuing *pupils* being *in charge* of their learning experiences, in the second interview those mentions decrease with a concurrent increase of *behaviourist* mentions.

to technology integration was common to all contexts and particularly close to the core of discussion for Cypriot and Italian participants. To the contrary, the Dutch interviewees shifted from a more learner-focused approach in the previous interview to a more teacher-oriented approach for technology integration, then. Thus, while it seems that through time and design experiences these student-teachers grew a common fairly open set of technology-related dispositions (see §Chp.2.1), their pedagogy-related dispositions proved multifaceted suggesting that in their professional future they might decide to integrate technologies according to different pedagogical perspectives.

CHAPTER 3.
TRACES OF REASONING: FOLLOWING PATHS ACROSS CASES

The very core of the present research lays within the exploration of student-teachers' reasoning when performing a design task for technologically-enhanced instruction. While still recognizing single cases' unique features, the paragraphs below will try to account for possible common patterns among the three contexts in regard to PR, so to provide a more robust explanation of the event itself (Yin, 1994).

Once more, participants' possible shared features will be described in two moments of their academic journey for technology integration: at the beginning (i.e. after the first design cycle) and after multiple experiences (i.e. after the second design cycle). This with the intent to get more insights on potentially common starting points for PR in the three cases, as well as the major modifications in time. As previously described (§Section C), the following findings emerge from the analysis of focused interviews (N= 36; see §B-Chp.3.3) of the duration of 30-45 min each, repeated twice per context.

In the following paragraphs the most and least mentioned reasoning dimensions will be first introduced, using as lens the PR adapted model already described in §B-Chp.3.1 (see Picture 3.1). This due to consistency considerations in analysing data through the different sub-questions, seeking to detect any instance (and characteristics) of reasoning dimensions in relation to the specific design tasks implemented, as per the main research question (§B-Chp.1).

Picture 3.1 PR adapted model in design tasks.

Then, the description will go deeper into the words of the interviewees, using ENA to visualize the focus of discussion and main connections among concepts. Finally, and to further approach the core of this research, it will be inspected if and how student-teachers recognized a match among their concerns and decisions when performing a technology-enhanced design task, and their given guidelines.

3.1 At the beginning of the academic journey for technology integration

The first design cycle was the moment in which student-teachers' reasoning about their design process for technology-enhanced instruction was first investigated. As the reader might recall, the prompt questions in this round of interviews would ask participants to describe the components of their design product, moving then to "why" questions to further investigate the decisional steps leading to it (§C- Introduction). Questions were formulated considering previous researches on pedagogical reasoning (§B-Chp.3.3) so to ideally address all the PR dimensions (Shulman, 1987; Starkey, 2010). Finally, participants were asked to state any connection between what they thought about when choosing how to create a technology-integrated learning unit, and their given design task procedures.

Figure 3.1 displays the frequency of interviewees' mentions per reasoning dimension, during the first interview round, in the three contexts. While this gives just an overall idea of how many interviewees would express some sort of concern related to the reasoning dimensions, and not its characteristics, it is still meaningful to observe how the three cases dwelled on the issues.

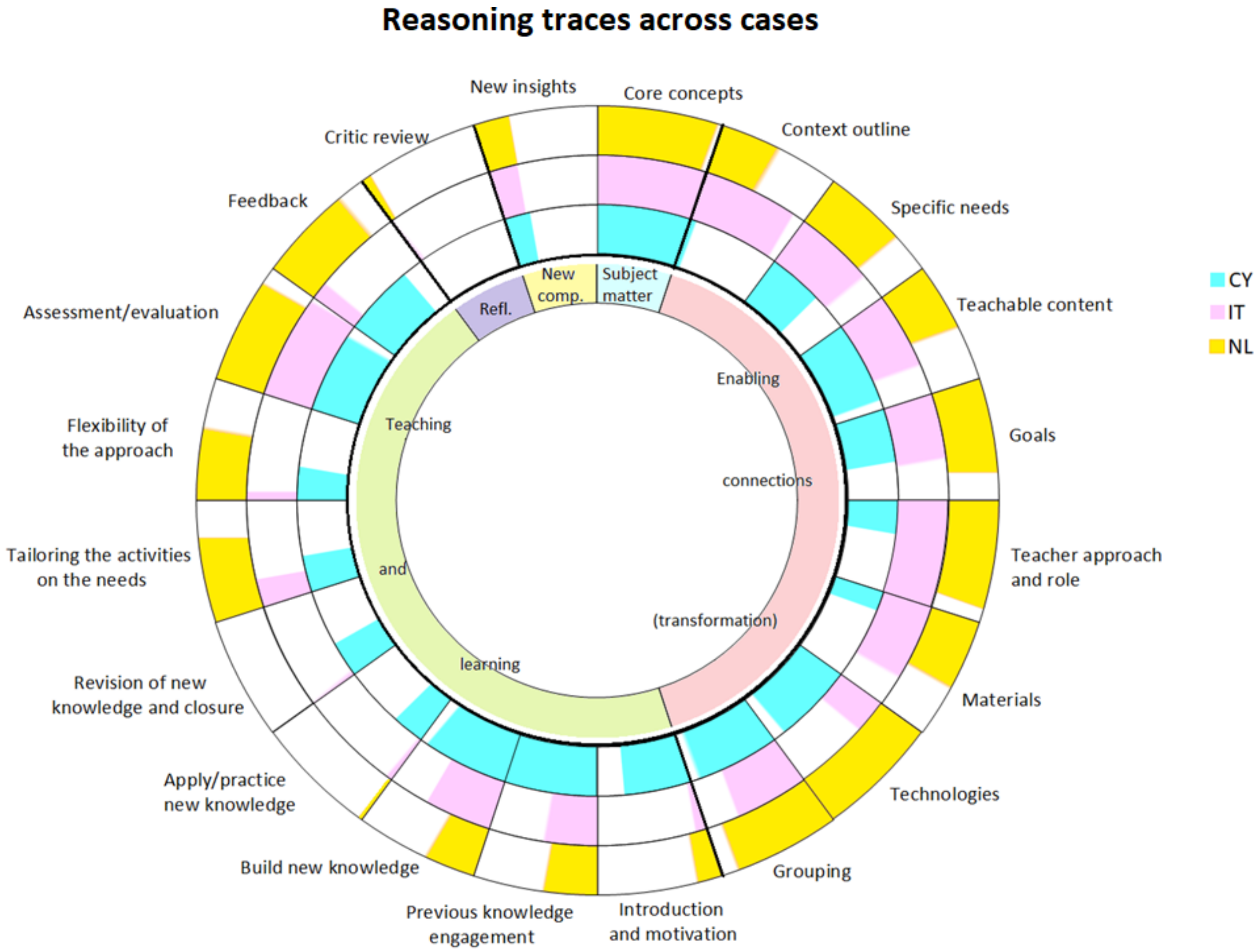


Figure 3.1 Traces of reasoning across cases - first interview (frequencies).

Starting from the *subject matter comprehension* dimension, it appears that almost every participant in all three contexts (92_{NL}-$100_{CY\text{-}IT}$%) declared having spent some time considering this point. As already described in the single cases (§Section C), some interviewees would consider teachers' identification of the subject/content mainly a matter of following National Curriculum indications; others would go deeper into the analysis of the core concepts of the identified discipline, either as disciplinary experts or in relation to the possible pupils. Given that in all three contexts content choice was the first design component mentioned by the interviewees, both chronologically and for importance[13], it could be inferred that content-related concerns figure as a critical starting point for all these pre-service teachers (as already of Shulman, 1987, p.14).

Other reasoning steps that see some sort of agreement (at least in numbers) across contexts, pertain to the *enabling connections – transformation* dimension: the contextual exploration of *specific needs* (56_{CY} – 69_{IT}%), and *goals* (61_{CY} – 77_{NL}%).

Interviewees' main concerns in the understanding of the educational *context specificities* included mentions of the type of school and educational level (NL), linguistic and socio-cultural background (IT), and previous/extra-school experiences (CY). *Goals* were also considered by most participants in the three contexts, usually in terms of content-related skills and knowledge, then further related when to the abovementioned context analysis (IT), when to technological resources identification (CY), or classroom-based activities and assessment strategies (NL).

Assessment is indeed a reasoning dimension which sees high mentions in all three contexts (77_{NL} – 94_{IT}%), with quotes about both formative and summative evaluation (NL, IT) and the need for coherence among these and the previous learning activities (CY).

Finally, other two reasoning dimensions seem to join the case studies, although in negative: *reflection* (0_{CY}-15_{NL}%)*,* and *new comprehension* ($31_{IT,NL}$ – 33_{CY}%). Few to none of the interviewees in any context would report to have self-assessed their own design process or product (*critic review*), mostly delegating the issue to external assessment by the course professor. A few more participants among the three cases, though, would indicate *new insights* on technology uses in education (CY, NL) and pedagogical approaches (IT).

Observing the dimensions in which there is a great difference among the three cases, the *teaching and learning* one, and the *technologies* step are noticeable. First of all, it appears

[13] We are here referring to the high co-occurrence of content-related quotes and expressions like "first of all", "to start", and others indicating a primate role of this issue in the interviewees' decisional processes.

that the Cypriot interviewees were generally keener to talk about the issues regarding *classroom-based practices*, if considered in terms of knowledge building and learning activation[14] (see §C-Chp.1.3). Several Italian and Dutch interviewees would instead mention these practices in terms of actions, interactions and tasks, thus scoring just apparently low in the figure. When it comes to *personalization* strategies, there seems to be a higher interest by the Dutch participants, followed by the Cypriot and just from a far by the Italian ones. Interviewees from the Netherlands would express an idea of teacher to the service of their pupils (in the *teacher role* area) sometimes even delegating to them the shape of the educational event[15], which in turn might have made them value greatly issues like *tailoring* and *flexibility*. More moderate, the Cypriot participants would mention being open to modifications in terms of time allowed for a single task, or slight teaching approach modifications, preferring to stick to the overall structure for building knowledge[16]. Finally, Italian interviewees would consider the different learning needs of their pupils (as per contextual *specific needs*) but prefer to stick to the original plan instead of modifying it mid-practice.

Last but not least, mentions of decisions for *technology* uses see the Dutch (100%) and Cypriot (83%) interviewees quite far from the Italian ones (just at 38%). As seen in the single cases' analysis, the technological issue would not be perceived relevant by many Italian participants as they were free not to deal with it in this design cycle. Conversely, given the same freedom, every Dutch participant would mention dwelling upon the identification of technologies useful to visualize/access the contents. Cypriot interviewees were strictly required to embed technology in their design, reporting uses similar to the ones of the Dutch participants, when not for transforming the content from expert-level to teachable.

[14] This perspective on data analysis was adopted in coherence with the social constructivist assumptions of the present research (see §B-Chp.2.1).

[15] See §C – Chp.3.3.

[16] See §C-Chp.1.3.

As already perceivable, the mere frequencies of mentions do not give the full picture of the interviewees' concerns when deciding how to shape their learning unit. To further explore the qualitative characteristics of the reasoning comments, ENA was used. In Figure 3.2 it is possible to see the focus of the first-round interviews in the three cases, with the main connections among issues. To allow a better understanding for the reader, the three overlapping networks have been here juxtaposed.

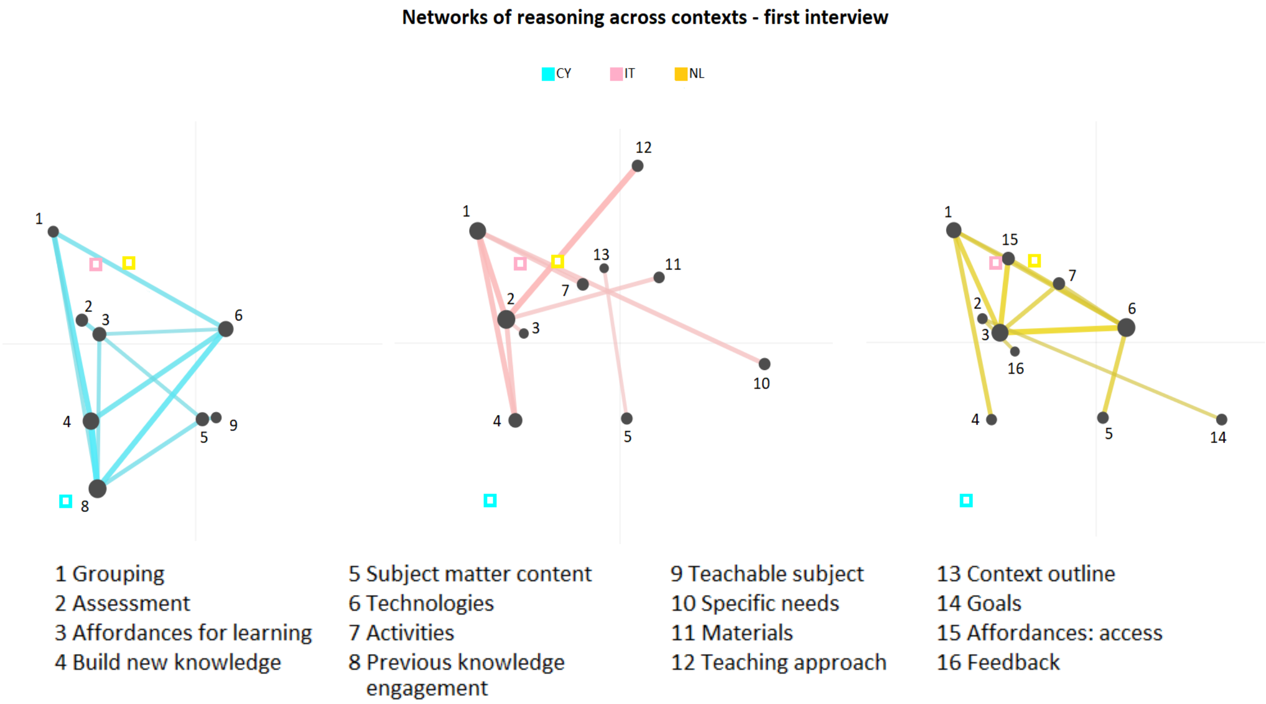


Figure 3.2 Networks of reasoning across contexts - first interview (connections among codes).

Looking at Figure 3.2 some of the common reasoning areas abovementioned can be easily re-traced, in the dots showing in every network (number 1 to 5), respectively *grouping*, *assessment,* technologies' *affordances for learning, build new knowledge* and *subject matter*, their sizes changing with the number of frequencies.

While individual/social forms of learning (*grouping* – 1) hold different numbers of frequencies in the three contexts, they always seem connected to classroom-based activities aimed to *build new knowledge* (4), sometimes in connection to the possible uses of *technologies* (6 – in CY and NL), others to the *specific needs* of the pupils (10 – in IT), or to *assessment* strategies (2 – in IT and NL). These last ones, relevant in every context, share also the link to technological *affordances for learning* (3), indicating that to the interviewed student-teachers, the importance of technology use to shape learning is somehow connected to the need for evaluation more than, for example, to the processes of *building new knowledge* (4 – never connected to it).

Furthermore, *subject matter content* (5), although present in every context, has peculiar connections in each one: in Cypriots' words, the identification and understanding of the content is strongly related to the pupils' *previous knowledge engagement* (8), concerns to make the *subject teachable* (9) and *assessment* strategies (2). In the Italian context, *content* (5) seems significantly related only[17] to the *context outline* (13) as the school setting, grade etc. Finally, in The Netherlands, content definition is connected only to concerns about *technologies* (6).

Once again, it appears that the Cypriot network alone presents knots dealing with strategies to make the content accessible (*teachable content* – 9) and engaging *pupils' previous knowledge* (8), displaying its centroid (i.e. centre of discussion) close to the latter. On the other hand, the Italian and Dutch networks share the knot of *activities* (7), the first in relation to *grouping* (1) concerns, the latter to *technological* (6) ones.

The Italian network shows peculiar knots as the consideration of pupils' *specific needs* (10), and the exploration of the *contextual outline* (13), as well as concerns about *materials* (11) and *teaching approaches* (12). Finally, in the Dutch network appear distinctive comments on *goals* (14), *feedback* strategies (16) and technological *affordances for accessing* the content (15). This last knot seems close to the central focus of both Dutch and Italian participants' discourse, within the first round of interviews.

Finally, the possible role of the design task guidelines in enabling the configuration of said networks of reasoning was also explored. In the first round of interviews participants (N=12 per context) were asked to ground, where possible, the decisional steps discussed to parts of the given guidelines for the task. In Figure 3.3a, b (on the next page) it can be seen how many interviewees in each context would comment on a reasoning dimension (bars' outline), and how many would attribute their concerns on the issue to their task guidelines (bars' coloured areas).

[17] It is to highlight that in the multiple-network comparison, only the strongest connections pass the threshold, while if looking closely to the single context, more inner connections among codes would be visible (see §Section C).

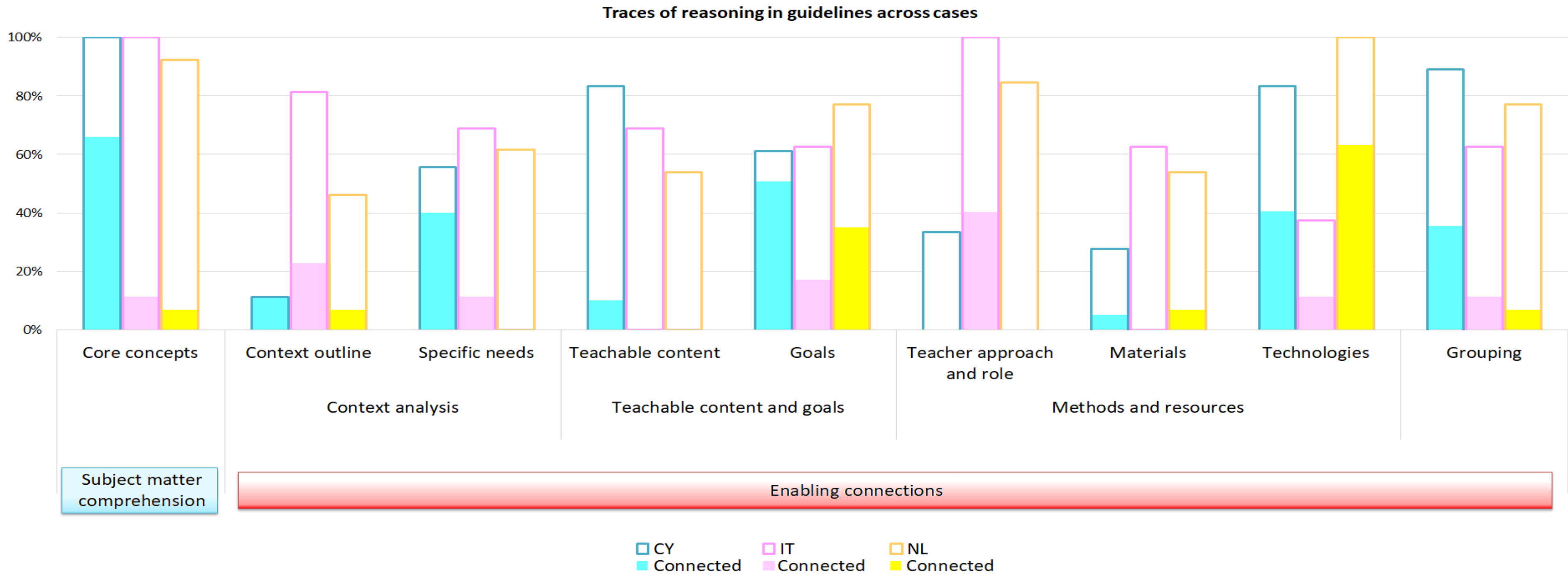


Figure 3.3a. Traces of reasoning in guidelines across cases - first interview (frequencies).

At a first glance it seems that the given instructions to perform a technology-enhanced design task were not perceived so determinant in the decisional process necessary to carry it out, in the judgment of the first-round interviewees. Starting from Figure 3.3a, the three contexts seem to share a particularly low attribution of guidelines' influence in reasoning areas like *context outline* exploration (8_{NL} – 25_{IT}%), strategies to make the *content teachable* ($0_{IT,NL}$ – 11_{CY}%), and *materials'* identification (0_{IT} – 8_{NL}%). Overall, it seems that the Cypriot interviewees would recognize a stronger role for their guidelines in shaping their decisional process for design, compared to the other two cases, who would be similar in their judgment on most areas, with the exception for *teacher approach and role* (to which 44% of Italian interviewees would notice reasoning prompts in their guidelines) and *technologies* (matched by 69% of Dutch participants).

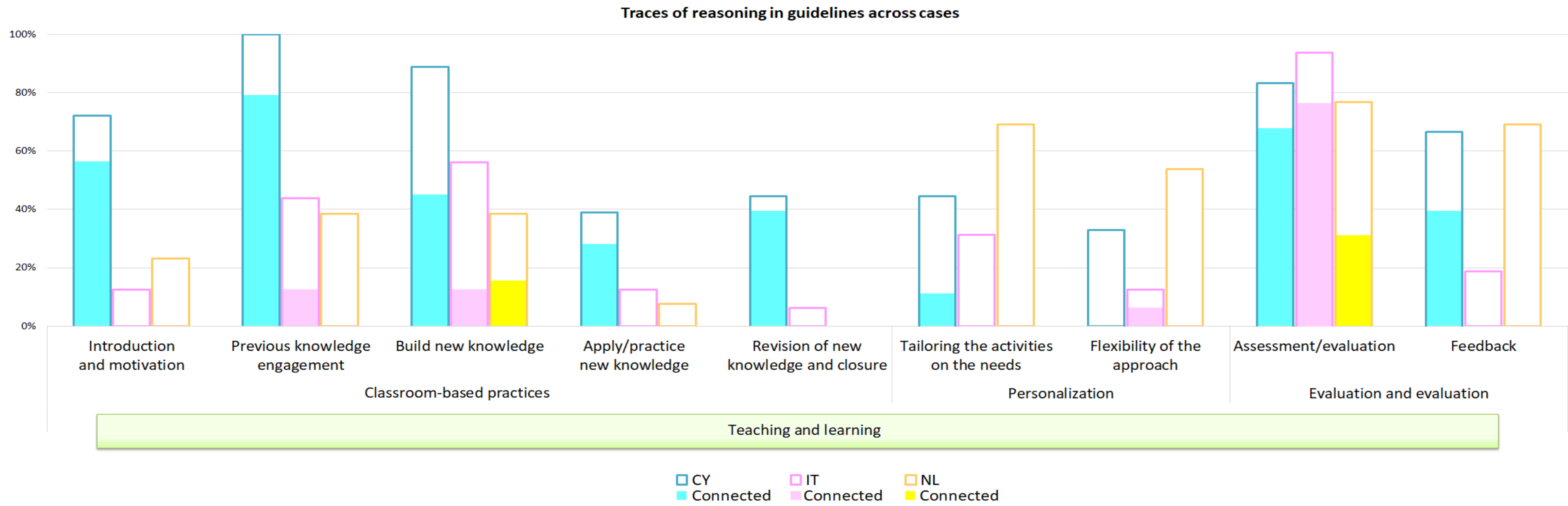


Figure 3.3b. Traces of reasoning in guidelines across cases - first interview (frequencies) - continues.

Moving on to Figure 3.3b, it can still be seen how in the *teaching and learning* reasoning dimension the Cypriot interviewees would attribute the highest influence to their guidelines compared to Italian and Dutch participants (with the exception of *assessment*), although once again no context sees a complete match. On the other hand, Dutch interviewees continue being the lowest among the three contexts in finding in their guidelines any prompt for reasoning[1]. Guidelines were perceived particularly not-relevant by all three contexts for reasoning areas like *flexibility of the approach* ($0_{CY, NL}$ – 6_{IT}%), and by Italian and Dutch participants for *apply/practice new knowledge* ($0_{IT, NLY}$%), *tailoring practice* ($0_{IT, NL}$%), and *feedback* practices ($0_{IT, NL}$%). To the contrary, *assessment* was a reasoning dimension on which the three contexts agreed to find some correspondence in the given guidelines (31_{NL} – 75_{IT}%).

[1] As it will be described shortly, this could be related to the low rate of actual use of the given guidelines, by the Dutch participants (see also §C-Chp.3.4).

Finally, about *reflection* and *new comprehension* reasoning dimensions. As already described, the three contexts did not comment a lot on a *critic review* of their processes (max 15% in The Netherlands' words) or the *new insights* these would foster (max 33% in Cypriots' words). Every interviewee who mentioned these two reasoning areas, though, did so in relation to the design task carried out, and the guidelines followed to do it.

3.2 AFTER MULTIPLE ACADEMIC EXPERIENCES FOR TECHNOLOGY INTEGRATION

Student-teachers' reasoning about their design process for technology-enhanced instruction was investigated also during their second design task. The second round of interviews included a make-believe situation to let the interviewees free to bring up any concern and decisional step on their own, always supporting the think aloud session with "why" questions to further investigate such decisional steps leading to the creation of the learning unit. In Figure 3.4 the interviewees' mentions per reasoning dimension emerging in these second-round interviews are displayed.

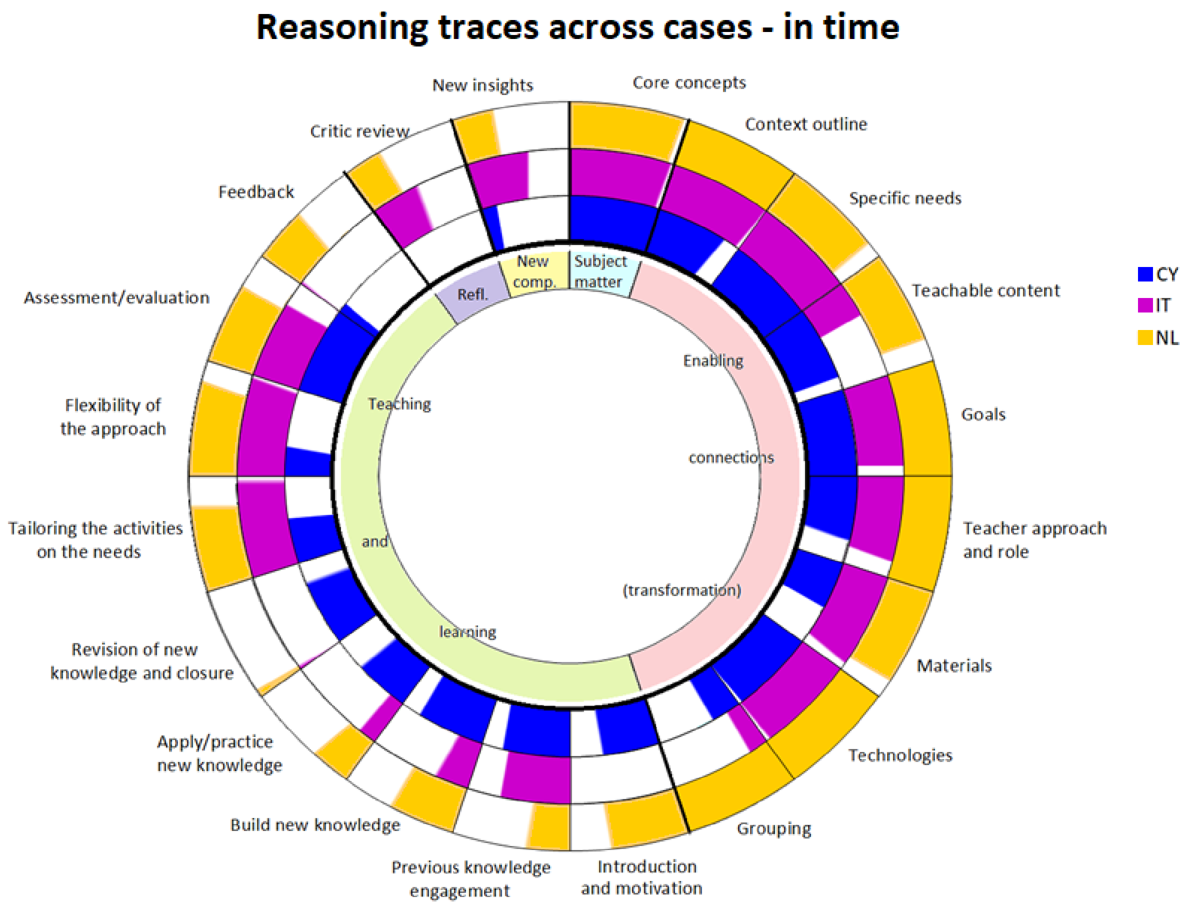


Figure 3.4 Traces of reasoning across cases - second interviews (frequencies).

Once again, the three contexts seem to show a similar trend of high comments on *subject matter comprehension* (92_{NL} – 100_{CY}%), *contextual exploration* (75_{CY} – 100_{NL}%) and its *specific needs* (85_{NL} – 100_{CY}%), *goals* (87_{IT} – $100_{CY, NL}$%), and *technology* uses (92_{CY} – 100_{NL}%). Overall, the whole *enabling connections / transformation* reasoning dimension gained mentions in every context compared to the previous round of interviews, with one exception. Fewer Italian interviewees than before would report pondering the ways (and reasons) to make the *content teachable* (from 69% to 40%), contrasting the trend showed by both Cypriot and Dutch interviewees.

The three contexts are joined in an increased attention towards *technology* integration decisions, in comparison to the previous design cycle, with comments related to technology's affordances for improving comprehension (CY, IT) and building new knowledge (CY); for visualizing the content (NL) and enabling active and cooperative learning strategies (NL, IT, CY).

Interestingly, now *grouping* and *assessment* decisional steps do not see the same shared trend as in the previous interview round, with more Dutch participants dwelling about individual/social learning modalities than Italian and Cypriot interviewees (diminished even within their own contexts). Conversely, now lesser Dutch and Italian participants would mention *assessment* issues in comparison to their previous interviews, while the Cypriots seem more interested in the topic.

In general, in the *teaching and learning* dimension it is still noticeable the high number of Cypriot interviewees talking about the steps to build knowledge, but the other two contexts also increased in most areas. So much so that in *tailoring* and *flexibility of the approach,* the Cypriot comments are outnumbered by the Dutch and Italian ones. Nevertheless, all three contexts share the increasing trend of mentions on the issue of *tailoring* practice according to emerging and stated needs.

One reasoning step that joins all three contexts in negative, i.e. with a decrease from the first interview round, is *feedback.* While interviewees would not declare they would not consider giving feedback for some reason (as they sometimes would in the previous interview), the matter simply was not brought up in their think aloud about what is essential to consider in a lesson.

As for *reflection* and *new comprehension,* it appears an increasing trend in the words of Dutch and Italian interviewees, who would report also *new insights* on the overall professional skills (IT) or technology value in education (NL), while no modification occurred in Cypriot comments about critic self-assessment of their own design process or product (*critic review* - still delegated to the course professor).

Once again, as frequencies of comments do not give the full picture of the interviewees' concerns when deciding how to shape their learning unit, ENA was used to further explore the qualitative characteristics of the reasoning quotes. In Figure 3.5 the focus of the second-round interviews in the three cases, with the main connections among emerging issues are displayed. To allow a better understanding for the reader, the three overlapping networks have been here juxtaposed.

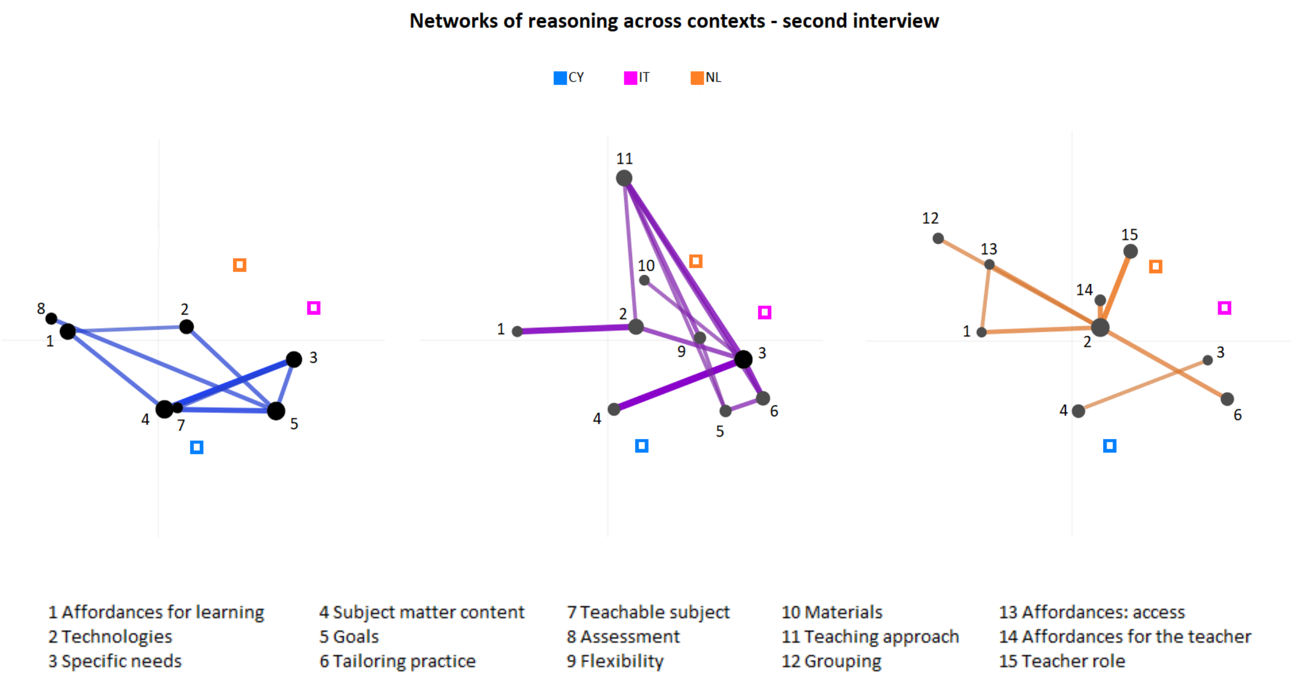


Figure 3.5 Networks of reasoning across contexts - second interview (connections among codes).

In Figure 3.5 are immediately re-traceable the common reasoning areas abovementioned, in the dots 1-4 shared by every network (albeit with different size), namely *affordances for learning, technologies,* contextual *specific needs,* and *subject matter content.* Quotes about *technology* uses (2) within a learning unit joined the three contexts in the correlation with concerns about *affordances for learning* (1), but presented also some peculiarities: in Cypriot participants' words, understanding of *technology* uses is connected to the *goals* (5) identified for the lesson, whereas for Italian interviewees they relate mostly with pupils' *specific needs* (3) and the possible *teaching approach* (3). Finally, for the Dutch participants, *technologies* are a central concern, linked to issues of *tailoring practice* (6), *teacher role* (15), *grouping* strategies (12), but also to considerations about possible *affordances for content access* (13) and for *teacher ease* (14).

Italian and Dutch interviewees share an interest in *tailoring practice* (6), the first in connection to the *goals* (5), pupils' *specific needs* (3) and *teaching approach* (11), the latter to *technologies* (2). Educational *objectives* (5) are a common concern also between Italian and Cypriot participants, where in connection to *flexibility* issues (9 – IT), where to pupils' *specific needs* and *assessment* (respectively number 3 and 8 - CY).

Overall, the distinctive issues characterizing contextual networks in the previous round of interview are still visible in the second ones, but different are the common focuses in the discussions. The three contexts do not share anymore the mentions of *assessment* (now only in the Cypriot network), *grouping* and *building new knowledge* (which disappeared altogether[1]).

Even the centroids of discussion moved in this second-round of interviews, seeing Cypriot student-teachers move from a central consideration of how to engage pupils' previous knowledge to one of how to transform the subject matter into *teachable content* (7) to the benefit of their pupils. Italian student-teachers loosely follow the same trend in shifting from an attention on technologies' affordances for content access to a focus on *pupils' specific needs* (3) in the learning experience. On the other hand, Dutch participants pose now closer to a stronger consideration of the *teacher role* (15) within the educational experience. As seen in the single case reports (§Section C), time and multiple design experiences possibly made student-teachers more aware and sensitive to the specific educational context in which they are called to operate, along with empowering them in their perception of the teacher role. Nevertheless, the kind of teacher and learning experience they eventually reason about, influenced also by their technological and pedagogical dispositions (see §Chp.2), is not homogeneously characterized among contexts.

Once again, after the second design cycle, interviewees were asked to identify a connection between the decisional steps discussed and the given guidelines, through the identification of parts in the latter most relevant for shaping the former. In Figures 3.6a, b (on the next page) it is possible to see how many interviewees in each context would comment on

[1] It is to highlight that in the multiple-network comparison, only the strongest connections pass the threshold, while if the single context is looked at more closely, other inner connections among codes would emerge (see §Section C).

a reasoning dimension (bars' outline), and how many would attribute their concerns on the issue to their task guidelines (bars' coloured areas).

At a first glance it seems that the instructions given to perform a technology-enhanced design task were still not perceived so determinant in the decisional process necessary to carry it out, for the second-round interviewees. Nevertheless, great improvements in the matching involved several reasoning dimensions across contexts. The three contexts joined in the increase of guidelines' influence acknowledgement with regards to reasoning areas like *context outline* and *specific needs, teacher approach and role, grouping,* and *build new knowledge.*

Whereas in no reasoning area there was a shared decrease of attribution to the guidelines, tow contexts out of three would agree on such trend for *materials* (CY, NL), *technologies* (CY, NL) and *assessment* (IT, NL). Furthermore, on three reasoning areas, namely *tailoring practice, flexibility of the approach* and *feedback,* the three contexts agreed in finding no prompt at all for reasoning in their given guidelines, after their second design cycle.

Finally, about *reflection* and *new comprehension* reasoning dimensions. As already described above, two out of three contexts (IT, NL) increased their comments on a *critic review* of their processes (max 38% in The Netherlands' words) and the *new insights* these would foster (max 60% in Italians' words). Every interviewee who mentioned these two reasoning areas, then, did so in relation to the design task carried out, and/or the guidelines followed to complete it.

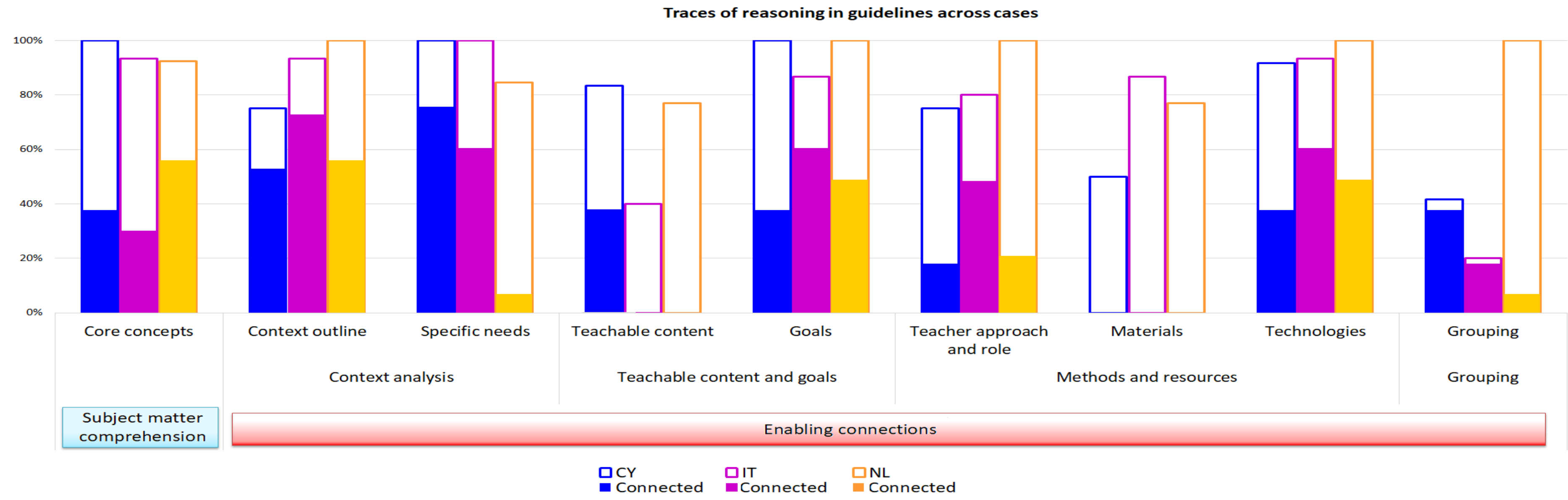


Figure 3.6a Traces of reasoning in guidelines across cases – second interview (frequencies).

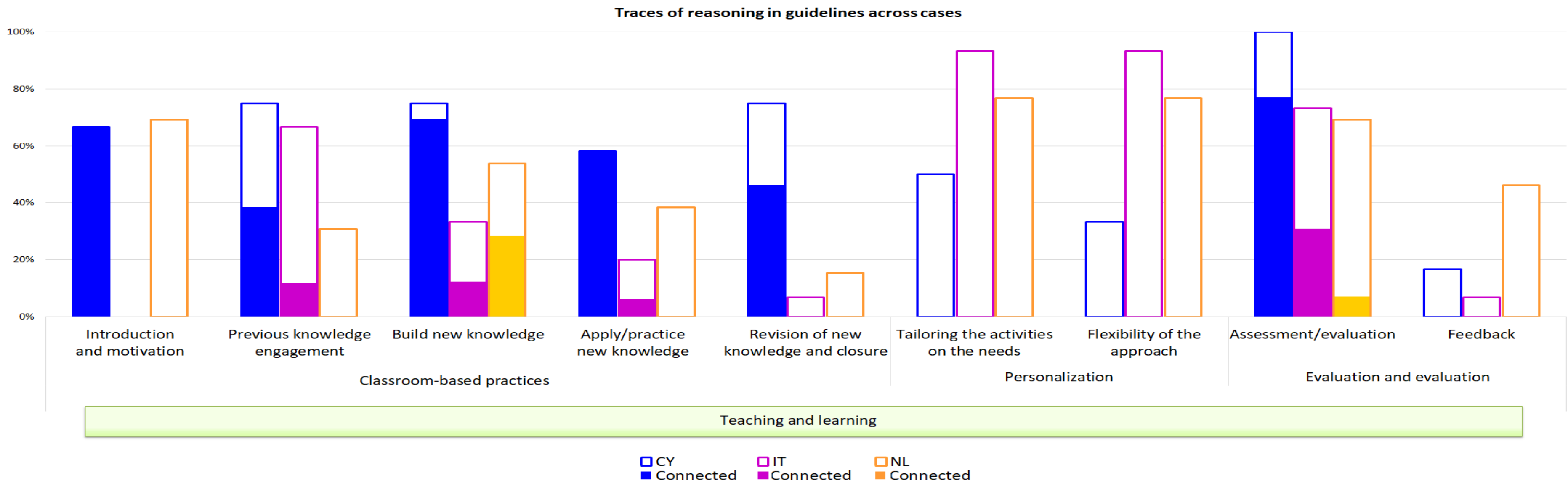


Figure 3.6b Traces of reasoning in guidelines across cases - second interview (frequencies) - continues.

CHAPTER 4.
CROSS-CASE FINDINGS FOR DESIGN TASKS RELEVANCE IN ENGAGING PR

In the previous paragraphs cross-case findings for the three sub-questions informing the present research were presented, as per sub-question 4 (§B-Chp.1). In the next paragraphs, a possible interpretation for such findings will be introduced considering the existing literature, with the aim to answer the main research question (§B-Chp.1): *how can TPCK-informed instructional design tasks, as implemented in initial teacher education, engage student-teachers in pedagogical reasoning?*.

The present multiple case study engaged a total of 345 student-teachers across three European university contexts for initial teacher education. Such population included mainly 17-22 years old, female student-teachers training to work at pre-primary to lower secondary school level in their own country. At the beginning of this study, participants stated to have wide access to modern technologies (i.e. owning personal devices connected to the internet) and to use overall fairly well lower order technologies like Office suite (or equivalent) and internet-based ones (e.g. emailing systems and researching databases). On the other hand, the leisure use of technologies, e.g. on social media, gathered different interest among the participants, who also rated themselves quite unfamiliar with the use of technologies more specialized for education (e.g. interactive whiteboards, concept mapping tools, simulations). As seen previously, participants changed in their ratings about knowledge of use of educational technologies as well as in their perception of support by their universities, at the end of the attended academic course for technology integration. These findings align with the literature on the great potential of initial teacher education programmes in fostering the development of professional expertise for technology integration (e.g. SQD model - Tondeur et al., 2012, 2016; see also Agyei & Voogt, 2011; Drent & Meelissen, 2008; Farjon et al., 2019), especially when engaging student-teachers in design tasks (Angeli & Valanides, 2009, 2013; Baran & Uygun, 2016; Koh & Chai, 2014; Koehler & Mishra, 2005a,b; Mouza et al., 2014).

Aside from the knowledge of use of technologies, exploring student-teachers' dispositions toward technology integration helped in better comprehending the design decisions possibly guiding their actual behaviours (Ertmer, 2005; Ottenbreit-Leftwich et al., 2018; Niederhauser & Lindstrom, 2018; Forkosh-Baruch, 2018; Knezek & Christensen, 2018; Scherer et al., 2018; Voogt et al., 2012; Yeh et al., 2017). Notwithstanding the individual and context-specific peculiarities (see §Section C), incoming student-teachers would seem to gather around four patterns of dispositions (i.e. profiles). Two of them would show some kind of extreme position: Adam being disengaged and sceptical about the personal capability and professional worth of integrating technologies; and Daan posing as self-sufficient, already nearly expert and almost recklessly positive towards the matter. Other two profiles, more moderate, were the one of Beatrice, keen on perceiving the potentialities of technologies for learning but doubtful (yet motivated) about her practical capabilities to realize them; and Chara, quite self-confident on her skills but more wary about the professional and personal implications to integrate technology in the classroom. Interestingly, although the three case-based groups of participants would indeed show a propensity for one profile over the others, all three contexts were represented by the different profiles, suggesting a shared configuration of student-teachers' dispositions at the beginning of their university course. Furthermore, while the overall population (i.e. three cases altogether) was mainly female, the male minority gathered significantly more around the last, self-sufficient profile[1]. Further research would be advised to better explore possible gender-related issues, as some literature seems to suggest a higher (or over-) perception of self-confidence in males compared to females (Cassidy & Eachus, 2002; Madigan, Goodfellow & Stone, 2007; Pajares, 2002 - §Section E).

At the end of the attended academic course for technology integration, participants showed significantly increased rates of self-efficacy and perception of their practical enactment of TPCK practices. Considering that their knowledge of use of educational technologies and appreciation of academic support aligned on this positive trend, these findings would suggest a positive dispositional basis for the participants. Such findings could also figure as enablers of possible enhanced willingness to choose and participate in technology-integrated activities (Abbitt, 2011; Ertmer & Ottenbreit-Leftwich, 2010; Tondeur et al., 2016a, 2017, 2019).

Furthermore, the student-teachers' dispositional patterns changed through time, modifying the possible representative profiles. Indeed, the most typical participant eventually emerging across the three contexts was represented by a new profile: Francis. Her approach to integrating technologies shows open and positive attitudes and a very good self-efficacy, associated with a fair perception of theoretical and practical TPCK. These findings would suggest a fruitful shift in participants' dispositions towards technology integration, by the end of the course more aware of the issues that the use of technology may bring along, yet willing and confident about their personal and professional capabilities to realize in their practices the perceived ICT's potentialities for learning. As reported in the literature, teachers' understanding of advantages for teaching/learning

[1] To give some further information on this: Adam (2 males, 42 females); Beatrice (6 males, 68 females); Chara (4 males, 91 females); Daan (15 males, 57 females).

brought by technologies, joined with a good self-confidence in realizing such benefits, could greatly influence the intention and possible future enacted behaviour to integrate (Ertmer & Ottenbreit-Leftwich, 2010; Joo et al., 2014, 2018; Kimmons & Hall, 2016; Ottenbreit-Leftwich et al., 2018; Petko, 2012).

As for the pedagogical perspective of these dispositions, pre-service teachers seemed to enter their courses valuing the tailoring of practices in realization of meaningful learning experiences for the pupils, within an overall constructivist approach (CY and IT). However, some ambiguities emerged as the role of the teacher was sometimes blurred (CY), others more in control of the educational experience in a more traditional pedagogical perspective (NL and IT). In time, and through two cycles of design, participants' attributed value to learning-oriented affordances increased, along with a more empowered yet reflective idea of the teacher with a complex concept of TPCK within the educational practices. Nevertheless, such ideal of teacher, while more open and aware of the potentialities of technology integration for learning, was seen holding alternatively a more learner-centred (CY and IT) or teacher-centred (NL) perspective on their realizations. The progressive learning-centred orientation through technology-integrated experiences is not something new in the literature (see e.g. Angeli & Valanides, 2009; Smart, 2016; Valanides & Angeli, 2008), whereas the opposite trend is quite unusual. Such irregularity could account for an important co-occurring factor: Dutch student-teachers (and only them) were required to implement their second design product in real schools, possibly experiencing a "reality shock" (Tondeur et al., 2016). That, combined with several participants' *a priori* decision to not use the given guidelines as an operational framework to shape the design and its practice, could have made them rely on more traditional scripts for teaching. Further research would be recommended on this topic (§Section E).

In §Section C was already described how student-teachers' technological pedagogical dispositions would align with the elicited reasoning process for a design task, accounting for a progressively more open and intentional approach to technology integration while growing a multifaceted ideal of teacher role in it. All three groups of participants would elicit first their understanding of the *subject matter*, reminding of what already stated by Shulman: "most teaching is initiated by some form of 'text': a textbook, a syllabus or an actual piece of material the teacher or student wishes to have understood" (Shulman, 1987, p. 14). Said comprehension of the subject matter would consider the national curriculum and disciplinary expertise, growing more situated in time, with concerns closer to the educational context in which to teach the identified content (similarly to Smart, 2016; Smart et al., 2015; Webb, 2002). It seems that, for the engaged participants, the distinction between the *subject matter comprehension* dimension and the *enabling connections/transformation* one narrowed in time.

Within this last dimension, several interesting findings emerged. Through the two design cycles, the analysis of the *context* improved in depth and importance in participants' words, both in the overall outline and in the specific needs of the pupils (e.g. the type of school – NL; linguistic and cultural background – IT; previous/extra school experiences - CY). Other commonly addressed reasoning steps in this dimension were the identification of (content-related) *goals* for the learning unit, which seemed to pose as explicit realization of the connection between *subject matter comprehension* and contextual needs, in the words of the participants (as described by Shulman, 1987, in the *preparation* process within *transformation*).

When reasoning about *methods* and teaching approaches, student-teachers showed an increased awareness of the *role of the teacher* and the possible implications of choosing different approaches in shaping teaching and learning. Through two design cycles, participants progressively delved deeper into the definition of the teacher role in close relation to the actual organization of the learning experience (NL), to the learners' needs (CY and IT), and the surrounding educational context (CY, NL, IT). Interestingly, Dutch and Cypriot participants engaged more in considering how to transform the subject matter into *teachable content,* both considering the initial peculiarities of their pupils in the process, following closely the processes described by Shulman (1987) for *transformation*. On the other hand, Italian student-teachers preferred to reason more on how to transform the content and whole learning experience once in class, responding to emerging pupils' peculiarities through tailoring strategies. This could suggest a more in-action approach to processes like *adaptation* and *tailoring* within Shulman's *transformation* process (1987), reminding of Schön's (1987) concept of reflection-in-action, which "enables the practitioner to think deeply about situations while they are happening, interpret and frame them in particular ways and adapt his/her actions accordingly" (McKenney et al., 2015, p. 187, see also Loughran et al., 2016).

As for the reasoning on *materials* and *technologies* a gradual focussing of participants' words on resources' characteristics and affordances for learning could be seen in the three contexts. The (technological) tool identification considered coherence stances with the content and its goals (CY), the teacher approach (IT and NL), and tailoring strategies (NL). Participants explicitly engaged in reasoning about the extent, modalities and consequences of ICT integration on their design products, reminding of the importance of the affordances' awareness within the reasoning process, already suggested in the literature (see Feng & Hew, 2005; Smart, 2016; Webb & Cox, 2004).

In the *teaching and learning* dimension, considerations on *classroom-based practices* varied greatly according to the case with the Cypriot student-teachers most inclined to reason about the processes leading pupils building knowledge from their naïf one, although Italian and Dutch participants showed some improvement on this as well, through time. A further possible hint to such enhanced sensibility to the learning processes for knowledge building could be the decrease, in Dutch and Italian student-teachers' words, of the primate of final *assessment* activities, although still overall important to them. Most noticeable was the increased attention for *personalization* practices, common to all three cases albeit at different rates. This seems to suggest a link between the greater concern for contextual and pupils' characteristics before enacting the learning unit, and the actual practices to include learners' differences and needs in the best possible learning experience. Findings on *teaching and learning* as the observable acts of teaching (Harris & Phillips, 2018) were particularly indicative of the influence of participants' dispositions on their reasoning (Bryan & Tippins, 2006; Smart, 2016; see also Knezek & Christensen, 2018; Voogt et al., 2012): as already described, student-teachers matured an idea of educational experience as meaningful for the pupils, characterized by flexibility and tailoring of the teaching approaches (eventually more aware and defined), and a learning-oriented use of technologies' affordances.

Finally, the last two reasoning dimensions (i.e. *reflection* and *new comprehension*) gained some space in participants' minds, whether in consideration of the teaching profession overall (IT) or of the specificities of technology integration (NL). Related reasoning mentions were particularly tricky to detect, possibly also because the design products had not been implemented in real-life contexts in two out of three cases (see the concept of teachers' concerns in Nilsson, 2009). Indeed, Italian student-teachers worked on their second design task in light of their first one, either revising it or considering it when creating a new one, and this could have helped their growth in reflection and new insights (Nilsson, 2009). Furthermore, the Dutch participants were the only ones actually enacting their second design product at school, and they were also quite keen on mentioning critic reviews of their own work and new comprehensions about it, possibly suggesting a link between these reasoning dimensions and practical experiences (as already implied in Shulman's -1987 - original idea that pedagogical reasoning develops through planning, teaching and reflecting on the classroom experiences).

Overall, through two design cycles, the main focus of discussion about reasoning shifted, in the three contexts, towards a deeper analysis of the pupils needs (IT) also in the shape of a teachable content (CY), with an empowered consideration of the teacher role in the educational experience (NL).

In these paragraphs were summarized the findings for student-teachers' knowledge of use of technologies, dispositions towards its integration, and finally and foremost the kind of reasoning (inevitably influenced by those factors) leading the design of a TPCK-informed learning unit. What was the impact of the design tasks and guidelines offered by the three initial teacher education programmes, on such findings?

Through time and possibly increased familiarity with both the task and its guidelines, participants would progressively recognize these as more relevant in shaping their pedagogical reasoning, although most of what they elicited was rooted elsewhere. Overall, the three procedures were eventually found most significant in triggering considerations within the *enabling connection/transformation* dimension (specifically, the analysis of the *context outline,* the definition of *goals,* and the identification of useful *technologies*).

On the other hand, when it comes to contemplating how to realize preliminary decisions within the classroom (*teaching and learning* dimension), it seems that student-teachers would rely heavily on sources of information and triggers for reasoning different from the given guidelines: e.g. personal experiences as students, internship experiences, or other strong convictions about how teaching and learning is supposed to happen. This could suggest that the three guidelines were perceived as useful yet theoretical/academic resource, difficult to actually implement in a real class[2], as supported by those student-teachers who would find no or limited worth in them (especially NL, but also in CY and IT).

Each of the three guidelines observed had its own strength when it came to influencing the student-teachers' reasoning: the Cypriot one was overall the most recognized relevant among the three cases, and specifically in the area of classroom-based activities, with a peculiar outcome on the participants' conceptualization of the role of the teacher (i.e. empowered and learner-oriented) and technologies (i.e. to the service of learning) in creating an integrated learning unit. The Italian guidelines had an interesting outcome on student-teachers' perception of technology (still to the service of the learners), eventually fully acknowledged as one of the intertwined issues to be actively considered when designing a learning unit. Finally, Dutch guidelines, while co-occurring with the growth of a teacher-centred perspective, influenced most participants' critic reflection on their performance as (student-) teachers, enabling new insights on the situated and complex nature of the reasoning process for technology-integrated design.

[2] Once again, in two out of three cases (i.e. CY, IT) the design products were not implemented, and this issue could have had implications on the perception of the usefulness of the task procedures for classroom-based practices. Unfortunately, the only group of participants who implemented in a real classroom their design product (i.e. Dutch ones) reported the *a priori* decision to not use the given guidelines, so such possible implications cannot be clearly identified yet.

Such multi-dimensional, non-linear characterization attributed by the participants to the various components of pedagogical reasoning for design is another commonality to all the cases. Although ever since the first theorization of pedagogical reasoning (PR&A, Shulman, 1987, see §A-Chp.3), it was never meant to be considered strictly linear, these findings seem to follow the suggestions of the literature (see Loughran et al., 2016; Smart et al., 2015; Smart, 2016) for a cycle of reasoning, even pushing for a network-like conceptualization. Nevertheless, a net-like conceptualization of reasoning was not the only one mentioned by the participants, some of whom would also express considerations of linearity, circularity, or redundancy of the different steps[3]. These empirical findings could suggest different levels within a same model of reasoning (e.g. in dynamic development, as participants were student-teachers), or distinct empirical models altogether. Further research would be needed to understand better the possible implications of such emerging structures for pedagogical reasoning (§Section E).

Further research would be also advised in relation to the classroom implementations of the produced designs, although the presented findings on the guidelines' impact on reasoning dimensions, as well as on securing dispositional enablers and good knowledge bases for technology uses, seem to be a powerful indicator of future meaningful integration.

[3] These were particularly evident in the part of the second-round focused interview in which participants were asked to create maps with the guidelines' items they perceived relevant, so to visualize their reasoning processes. As already described (§C- Introduction), it was not possible to include those further data in full, in the present dissertation.

SECTION E.
CONCLUSIONS, PRESENT CONSTRAINTS AND FUTURE PERSPECTIVES

SECTION INTRODUCTION

In this final section a conclusive overview of the findings will be reported (§Chp.1), recalling what already described more in detail in §Section C – Chp.1.4, 2.4, 3.4 and §Section D-Chp.4.

Moreover, limitations to the present research will be introduced, in relation to the implemented methodology and design as well as to the strategies for data collection and analysis (§Chp.2). Possible solutions to these issues will be proposed, in light of future research.

Finally, as the present study produced an amount of data impossible to fully account for in this dissertation, further steps of analysis will be introduced for the future, as well as possibly interesting inputs for new studies on the topic (§Chp.3).

CHAPTER 1.
OVERALL CONCLUSIONS

The present dissertation reports on a multiple case study research on student-teachers' pedagogical reasoning when performing TPCK-rooted design tasks, within European pre-service education contexts.

Section A presented the theoretical background to the study through the overview of (1) the Technological Pedagogical Content Knowledge (TPCK) framework for teacher knowledge in the technological era; (2) teachers' dispositions for technology integration in education, specifically pedagogical beliefs, self-efficacy and attitudes as strong predictors of behaviour; and (3) teachers' pedagogical reasoning for technology integrated practices, also in relation to different learning theories. Said threefold theoretical background posed the ground for the rationale of the study and the next section.

Section B introduced the research question: How can TPCK-informed instructional design tasks, as implemented in initial teacher education, engage student-teachers in pedagogical reasoning?. Then, the research approach and design are described as well as the different instruments for data collection: (1) documentation analysis, (2) participant observations, (3) focused interviews, and (4) a pre-/post- questionnaire. Closing this section was the explanation of the case units' selection process and a characterization of the participants' specificities.

Section C moved to data analysis and discussion on single case level, structured according to the research sub-questions' order. Findings emerging from the different instruments for data collection were triangulated wherever possible so to ensure a better validity (Yin, 2008). Specifically, it was sought a merged analysis of qualitative and quantitative data (namely interviews and questionnaire) in the definition of a single-case answer to the research question.

Section D reported on the cross-case analysis of the data, in the attempt to approach organically the phenomenon at study (i.e. student teachers' pedagogical reasoning for technology integration) and finally answer the main research question. Here, findings were observed regardless of single-cases' specificities to the advantage of a more comprehensive and reliable depiction of the phenomenon (Stake, 2006; Yin, 2008).

Overall, the outcomes of the present research were complex and multifaceted.

Findings suggest that the observed teachers' initial education courses and their design tasks had indeed a relevant impact in supporting student-teachers' growth of professional knowledge (TPCK) and dispositions for technology integration. At the beginning of the study, four profiles of student-teachers' were detected in relation to their dispositions and knowledge bases, but later data collection (i.e. post-questionnaire) showed that the observed courses managed to engage even the most extreme profiles shaping a new, more mature one. Eventually, the most common student-teacher profile showed to be open to technology integration, holding positive attitudes and a good self-efficacy associated with a fair perception of their own theoretical and practical TPCK. While these were not yet realized behaviours, self-efficacy and attitudes are recognized as powerful predictors (Banas & York, 2014; Scherer, Siddiq & Teo, 2015; Smart, 2016; Tondeur et al., 2017, 2019) for future practice, as "preservice teachers' attitudes and beliefs regarding ICT may indicate the extent and quality of ICT utilization" (Forkosh-Baruch, 2018, p. 427).

Furthermore, all three contexts displayed a modification in the conceptualization of the teacher, eventually more empowered and aware of their role within the educational experience. The idea of the teacher at the end of the two design cycles was one closer to a skilful and thoughtful practitioner (Loughran et al., 2016; Nilsson, 2009), concerned about the educational context and the specific pupils' needs as well as about technological affordances for learning. These findings are in line with other researches on the uses of design tasks to foster (student-) teachers' TPCK, as these make clear the situated interconnections among technology, content and the means to teach it (Baran & Uygun, 2016; Harris & Hofer, 2009; Koehler & Mishra, 2005b; Kramarski & Michalski, 2010; Mouza et al., 2014; Tondeur et al., 2012), while enhancing learner-centred orientation (see Chai et al., 2013).

Nevertheless, it is to point out also a minor but opposite trend emerging by one of the three contexts (NL) in which the idea of teacher, while progressively more aware and empowered, stirred towards a more teacher-centred perspective altogether, associated with a consideration of technologies' affordances for entertainment and/or teachers' ease. These findings seem to align with what already found in other researches (e.g. Heitink et al., 2016, 2017; Smits et al., 2019), in which teachers would mainly value affordances for attractiveness for the pupils and efficiency for the teachers (Smits et al., 2019). Furthermore, these outcomes, while in the minority, could account for something worthy to be further researched as pertaining to the only group of participants who both chose to not use the given guidelines and experimented their design in a real educational context.

Zooming in closer to the main research question abovementioned (and in §Section B-Chp.1), it seems that the observed design tasks and guidelines indeed triggered some sort of reasoning, recognized also by the student-teachers themselves. Each of the single cases' design tasks and guidelines had their strength in sparking areas of reasoning: on context sensitivity (CY, IT, NL), definition of learning goals (IT), classroom-based activities for knowledge building (CY), ICT affordances identification (CY, IT, NL), and a critic reflection on the profession (NL). Up to half of the participants in each context grew to deem their design guidelines some-to-highly worthy to be used in their future technology integrated learning units. Nonetheless, most of the reported reasoning instances resulted detached from the given tasks and guidelines. Particularly weak seemed the connection between student-teachers' decisional steps and the given design tasks guidelines about: understanding deeply the subject matter (CY, NL), transforming it to the benefit of the pupils (CY, IT, NL), identifying non-technological resources (CY, IT, NL), and enacting flexible and tailored strategies in-action (CY, NL).

All in all, the observed teacher education courses had the very positive outcome of supporting a positive configuration of student-teachers' dispositions and professional knowledge, both powerful enablers of technology-integrated future behaviours (Abbitt, 2011; Banas & York, 2014; Christensen & Knezek, 2018; Ertmer, 2005; Smart, 2016, Farjon et al., 2019; Knezek & Christensen, 2016; Voogt et al., 2012; Tondeur et al., 2019). Their overall impact on sparking student-teachers' reasoning appeared to be tricky, as there seem to be other factors influencing it (e.g. personal and internship experiences, among the ones mentioned). Considering the theoretical references for pedagogical reasoning (as per §Section A-Chp.3), it seems that Shulman's model of MPR&A (1987) found ground in student-teachers' reasoning instances even considering technology integration. Findings would also point to a non-linear conceptualization of the reasoning process, as already suggested by the idea of a *cycle* of reasoning (see Loughran et al., 2016; Smart et al., 2015; Smart, 2016). Moreover, other conceptualizations emerged, as network-like, redundant, hierarchical and more, urging for further research on possibly different levels of reasoning within a same model (considering a dynamic development within pre-service education) or distinct empirical models altogether.

Finally, the present research offers some consideration for teacher education programmes. The findings would suggest that a mandatory or elective stance of the guidelines' use should not be understated as it could have a powerful role in triggering a cognitive conflict in student-teachers, somewhat forcing them to engage with a new perspective on technology integration. Likewise, the actual implementation of the design tasks in real contexts seems relevant to further investigate and possibly support student-teachers' pedagogical reasoning and dispositions for effective technology integration.

CHAPTER 2.
LIMITATIONS TO THE STUDY

Many limitations to the present study have already been discussed (see §B. Chp.2.4, 3) and will be here just summarized. First, the chosen design (multiple case study) and the sample size of the research limit the possibility to generalize the findings across a larger population. Indeed, the present study builds on the contextual specificities of each case study in formulating an answer to the phenomenon at study. Nevertheless, the chosen design allowed for the investigation of commonalities among cases and an analytic (if not statistic) generalization of the findings (Robson, 2002). While the different sample size among contexts was not insignificant (especially considering the small Dutch population engaged), the similar number of interviewees could have helped contain the issue.

Secondly, the present research took place in three different countries with three different native languages, none of whom was the one in which the research was conceptualized: English. This surely had consequences on the data collection phase, both on the definition and implementation of the instruments (e.g. the opaqueness of questions' meaning – Cohen et al., 2007) and on the participants' reactivity. Several procedures were put in place to contain these limitations, as the collaboration with native speaker certified translators and researchers, or the data review by key informants. Nevertheless, it cannot be denied the possibility of accidental selectivity of the data in the documents and observations and strengthening the collaboration with native speaker researchers in the ideation and implementation of the research would be advised for the future.

Thirdly, the study relied strongly on self-reported measures as the questionnaire and the description of pedagogical reasoning by the student-teachers interviewed. This kind of measure is exposed to a reflexivity risk that could produce distorted data (Cohen et al., 2007). On one hand, an attempt to contain the issue was made through triangulating multiple sources of data. On the other, the purpose of this study was to investigate the student-teachers' reasoning as experienced by the key informants, so the possible gaps between their (elicited) perception of knowledge, dispositions and reasoning, and the actual teaching practice was not a major concern.

Finally, some issues arose in the implementation of the specific instruments of focused interviews and questionnaire, besides the possible language barrier abovementioned. While the think-aloud technique (van Someren et al., 1994) resulted indeed useful in accessing participants' decisional processes when performing a design task, the analysis of the emerging data proved tricky. In particular, the bottom-up coding for dispositions and reasoning instances was delicate as the distinction between a core value/belief or attitude and a conscious decision of action emerged as a very thin line. For future research it would be advisable a coding procedure with the collaboration of multiple coders, to strengthen the analysis. Moreover, the questionnaire implemented should be revised in length and content, as the high reliability of the factors would suggest some items could be deleted with a time benefit for the respondents. Further pilots would also be advised to control modifications and translations of the instrument.

CHAPTER 3.
IMPLICATIONS OF THE STUDY AND POSSIBLE FURTHER RESEARCH

The primary focus of the present research was to investigate student-teachers' pedagogical reasoning when performing TPCK-wise design tasks, as possibly triggered in initial teacher training courses. Findings would suggest that Shulman's original model of MPR&A (§A-Chp.3) maintains relevance in understanding (student-) teachers' pedagogical reasoning even when considering digital technologies. Notwithstanding the inclusion of Starkey's (2010) model specificities in the data analysis, no conclusive proof was gathered on the presence of a pedagogical paradigm specific for the technological era (e.g. connectivism) in shaping participants' reasoning (see also Harris & Phillips, 2018). Nevertheless, some of the data just briefly mentioned in the present dissertation would encourage further investigation on an empirically-based model for pedagogical reasoning. As previously mentioned, participants mapped their design components with the aim of eliciting the perceived conceptual connections among the underpinned decisional steps. What emerged was a multiplicity of configurations, from linear to cyclical, from recursive to net-like and so forth. It would be most interesting to deepen the analysis on these data, investigating possible levels of reasoning (considering they are pre-service teachers) or the evidence for a different empirical model altogether.

Moreover, and closer to the main research focus, the findings would suggest different strengths and weaknesses in the observed TPCK-informed design tasks in triggering student-teachers' pedagogical reasoning. This could have practical implications relevant to initial teacher education (ITE) programmes for a reflection on the preparation of future teachers. As widely acknowledged in the literature, ITE has a great influence on teachers' technology integration practices even in the long run (see Agyei & Voogt, 2011; Baran & Uygun, 2016; Christensen & Knezek, 2018; Ertmer & Ottenbreit-Leftwich, 2010; Farjon et al., 2019; Tondeur et al., 2012, 2016, 2017). In light of that, it would seem essential to continuously revise practices in the attempt to provide student-teachers with the knowledge, attitudes, confidence and abilities they will need to professionally reason in an efficient way for efficient acts of pedagogy (among others, Loughran et al., 2016; Christensen & Knezek, 2018; Shulman, 1987). The findings arising in the present study would suggest further analysis of the contextual educational strategies implemented in the cases observed, possibly in a wider consideration of the entire curriculum for teacher education. This could help better identify the roots of those reasoning instances mentioned by the participants, but not in relation to the attended course or task.

Another interesting aspect emerging from the study is the possible distance between what participants would reason about in an academic design task, and what they would indeed deem relevant in a real classroom experience. This could be outlined in the Dutch case study where student-teachers actually implemented their design at school and concurrently elicited a reasoning process and dispositional set quite different from the other two cases. At this moment is not possible to draw any conclusion on the topic (as the specific case study presented several other peculiar characteristics), but the findings would call for further investigation. For example, it would be interesting to explore the student-/novice teachers' possible "reality shock" (Tondeur et al., 2016) at the first school experience in terms of dispositions, specific reasoning model emerging, and ITE strategies to support them.

Finally, findings arising from the questionnaire would suggest further investigation of gender issues in the configuration of dispositions toward technology integration, particularly in relation to perceived self-efficacy. This would help better understanding the different student-teachers' characteristics when attending ITE, for an ever more tailored pre-service education.

REFERENCES

Abbitt, J. T. (2011). An Investigation of the Relationship between Self-Efficacy Beliefs about Technology Integration and Technological Pedagogical Content Knowledge (TPACK) among Preservice Teachers. *Journal of Digital Learning in Teacher Education, 27*(4), 134-143.

Abhari, K. (2017). A Connectivist Approach to Meeting the Needs of Diverse Learners: The Role of Social Technologies. Paper presented at *Teaching, Colleges & Community Worldwide Conference, Honolulu.* Retrieved at: https://www.researchgate.net/publication/314554159_A_Connectivist_Approach_to_Meeting_the_Needs_of_Diverse_Learners_The_Role_of_Social_Technologies

Adelman, C., Kemmis, S. & Jenkins, D. (1980) Rethinking case study: notes from the Second Cambridge Conference. In H. Simons (ed.) *Towards a Science of the Singular,* 45-61. Norwich: Centre for Applied Research in Education, University of East Anglia.

Adler, P. A., & Adler, P. (1994) Observational techniques. In N. K. Denzin and Y. S. Lincoln (eds) *Handbook of Qualitative Research,* pp. 377–392. London: Sage.

Agyei, D. D., & Voogt, J. M. (2011). Exploring the potential of the will, skill, tool model in Ghana: predicting prospective and practicing teachers' use of technology. *Computers & Education, 56*(1), 91-100. doi:10.1016/j.compedu.2010.08.017

Ajzen, I. (2012). Theory of planned behavior. In P. Van Lange, A. Kruglanski, & E. Higgens (Eds.), *The handbook of theories of social psychology* (Vol. 1, pp. 438–454). Thousand Oaks: Sage.

Albion, P. (2001). Some factors in the development of self-efficacy beliefs for computer use among teacher education students. *Journal of Technology and Teacher Education, 9*(3), 321–347.

Aldunate, R., & Nussbaum, M. (2013). Teacher adoption of technology. Computers in Human Behavior, 29(3), 519–524. https://doi.org/10.1016/j.chb.2012.10.017.

Allen, J. G., Wasicsko, M. M., & Chirichello, M. (2014). The missing link: Teaching the dispositions to lead. *International Journal of Educational Leadership Preparation*, 9(1), 1-13.

Anderson, S. E., & Maninger, R. M. (2007). Preservice teachers' abilities, beliefs, and intentions regarding technology integration. *Journal of Educational Computing Research, 37*(2), 151–172.

Angeli C., Valanides N., Mavroudi A., Christodoulou A., Georgiou K. (2015) Introducing e-TPCK: An Adaptive E-Learning Technology for the Development of Teachers' Technological Pedagogical Content Knowledge. In: Angeli C., & Valanides N. (eds) *Technological Pedagogical Content Knowledge*. Springer, Boston, MA

Angeli, C. (2017a). *Εκπαιδευτικη Τεχνολογια Διαγραμμα Μαθηματος (Educational Technology*) [Course summary].

Angeli, C. (2017b). *Αναλυτική Περιγραφή Του Σχεδίου Μαθήματος Με Βάση Το Οικοδομιστική Μοντέλο (Detailed description of the Instructional Design task based on the constructivist perspective)* [Teaching material collected through observation].

Angeli, C., & Valanides, N. (2005). Preservice elementary teachers as information and communication technology designers: An instructional system design model based on an expanded view of pedagogical content knowledge. *Journal of Computer Assisted Learning 21*(4), 292-302. doi: 10.1111/j.1365-2729.2005.00135.x

Angeli, C., & Valanides, N. (2009). Epistemological and methodological issues for the conceptualization, development and assessment of ICT-TPCK: Advances in Technological Pedagogical Content Knowledge. *Computers & Education, 52*(1), 154-168. doi: 10.1016/j.compedu.2008.07.006

Angeli, C., & Valanides, N. (2013). Technology mapping: an approach for developing technological pedagogical content knowledge. *Journal of Educational Computing Research, 48*(2), 199-221. doi: 10.2190/EC.48.2.e

Angeli, C., & Valanides, N. (2018). Knowledge Base for Information and Communication Technology in Education. In Voogt, J. et al. (eds.), *Handbook of Information Technology in Primary and Secondary Education, Springer International Handbooks of Education*, pp. 1-17. https://doi.org/10.1007/978-3-319-53803-7_26-1.

Angeli, C., & Valanides, N. (Eds.) (2015). *Technological pedagogical content knowledge. Exploring, developing, and assessing TPCK*. New York, NY: Springer.

Angeli, C., Valanides, N, & Christodoulou, A. (2016). Theoretical considerations and alternative conceptualizations of TPACK. In M. C. Herring, M. J. Koehler, & P. Mishra (Eds.), *Handbook of Technological Pedagogical Content Knowledge (TPACK) for Educators, 2nd Edition* (pp. 11-32). London, UK: Routledge.

Archambault, L. (2016). Exploring the use of qualitative methods to examine TPACK. In M. C. Herring, M. J. Koehler & P. Mishra (Eds.), *Handbook of Technological Pedagogical Content Knowledge (TPACK) for Educators, 2nd Edition* (pp. 65-86). London, UK: Routledge.

Archambault, L. M., & Barnett, J. H. (2010). Revisiting technological pedagogical content knowledge: exploring the TPACK framework. *Computers & Education, 55*(4), 1656-1662. doi: 10.1016/j.compedu.2010.07.009

Ausubel, D. P. (1978). In defense of advance organizers: A reply to the critics. *Review of Educational Research, 48*(2), 251–257. https://doi.org/10.3102/00346543048002251

Bailey, K. D. (1994) *Methods of Social Research (fourth edition).* New York: The Free Press

Banas, J. R., & York, C. (2014). Authentic learning exercises as a means to influence preservice teachers' technology integration self-efficacy and intentions to integrate technology. *Australasian Journal of Educational Technology, 30*(6), 728-746 https://doi.org/10.14742/ajet.362

Bandura, A. (1986). *Social foundations of thought and action*. Englewood Cliffs: Prentice Hall.

Baran, E., & Uygun, E. (2016). Putting technological, pedagogical, and content knowledge (TPACK) in action: An integrated TPACK-design-based learning (DBL) approach. *Australasian Journal of Educational Technology, 32*(2), 47-63. doi: 10.14742/ajet.2551

Baran, E., Canbazoglu Bilici, S., Albayrak Sari, A., & Tondeur, J. (2019). Investigating the impact of teacher education strategies on preservice teachers' TPACK. *British Journal of Educational Technology, 50*(1), 357–370

Barker, C. D. & Johnson, G. (1998). Interview talk as professional practice. *Language and Education, 12* (4), 229–242.

Baxter, P., & Jack, S. (2008). Qualitative Case Study Methodology: Study Design and Implementation for Novice Researchers. *The Qualitative Report, 13*(4), 544-559. Retrieved from: https://nsuworks.nova.edu/tqr/vol13/iss4/2

Baylor, A. L., & Ritchie, D. (2002). What factors facilitate teacher skill, teacher morale, and perceived student learning in technology-using classrooms? *Computers & Education, 39*(4), 395–414. https://doi.org/10.1016/S0360-1315(02)00075-1.

Bell, F. (2011). Connectivism: Its place in theory-informed research and innovation in technology enabled learning. *The International Review of Research in Open and Distributed. Learning, 12(*3), 21. https://doi.org/10.19173/irrodl.v12i3.902.

Bennet, S., Maton, K., & Kervin, L. (2008). The "digital natives" debate: A critical review of the evidence. *British Journal of Educational Technology, 39*(5), 775-786.

Ben-Peretz, M. (2011). Teacher knowledge: what is it? How do we uncover it? What are its implications for schooling? *Teaching and Teacher Education, 27*(1), 3-9. doi: 10.1016/j.tate.2010.07.015

Benton-Borghi, B. H. (2015). Intersection and impact of universal design for learning (UDL) and technological, pedagogical, and content knowledge (TPACK) on twenty-first century teacher preparation: UDL-infused TPACK practitioner's model. In C. Angeli & N. Valanides (Eds.), *Technological pedagogical content knowledge. Exploring, developing, and assessing TPCK* (pp. 287-304). New York, NY: Springer.

Blackwell, C. K., Lauricella, A. R., & Wartella, E. (2014). Factors influencing digital technology use in early childhood education. *Computers & Education, 77*(1), 82–90.

Bottino, R. M. (2004). The evolution of ICT-based learning environments: Which perspectives for the school of the future? *British Journal of Educational Technology, 35*, 553–567. https://doi. org/10.1111/j.0007-1013.2004.00413.x.

Bower, M. (2008). Affordance analysis--Matching learning tasks with learning technologies. *Educational Media International, 45*(1), 3 - 15. doi:10.1080/09523980701847115

Bowers, J. S., & Stephens, B. (2011). Using technology to explore mathematical relationships: a framework for orienting mathematics courses for prospective teachers. Journal of Mathematics Teacher Education, 14(4), 285-304

Breukelman, R. (2018). *Roster minor Leren en ICT 2017-2018* [Course Summary]. [Teaching material collected through observation]. Available also at: https://www.kiesopmaat.nl/modules/chw/B_E/136835/

Britten, J. S., & Cassady, J. C. (2005). The technology integration assessment instrument: Understanding planned use of technology by classroom teachers. *Computers in the Schools, 22*(3), 49-61. doi: 10.1300/J025v22n03_05

Brookfield, S. D. (1995). *Becoming a critically reflective teacher*. San Francisco: Jossey-Bass Publishers.

Brown, M. (2009). The teacher-tool relationship: Theorizing the design and use of curriculum materials. In J. T. Remillard & Herbel-Eisenmann, & G. Lloyd (Eds.). *Mathematics teachers at work: Connecting curriculum materials and classroom instruction* (pp. 17-36). New York, NY: Routledge.

Bryan, L.A., & Tippins, D. J (2006). Elementary science teacher education. In K. Appleton (Ed.). *Elementary Science Teacher Education: International Perspectives on Contemporary Issues and Practices,* 299–316. New Jersey: Lawrence Erlbaum Associates.

Buabeng-Andoh, C. (2012). Factors influencing teachers' adoption and integration of information and communication technology into teaching: A review of the literature. *International Journal of Education and Development using Information and Communication Technology (IJEDICT), 8*(1), 136–155.

Cassidy, S., & Eachus, P. (2002). Developing the Computer User Self-Efficacy (Cuse) Scale: Investigating the Relationship between Computer Self-Efficacy, Gender and Experience with Computers. Journal of Educational Computing Research, 26(2), 133–153. https://doi.org/10.2190/JGJR-0KVL-HRF7-GCNV

Chai, C. S. (2010). The relationships among Singaporean preservice teachers' ICT competencies, pedagogical beliefs and their beliefs on the espoused use of ICT. *The Asia-Pacific Education Researcher, 19*(3), 387–400.

Chai, C. S., Chin, C. K., Koh, Ling, J. H. & Tan, C.L. (2013a). Exploring Singaporean Chinese language teachers' technological pedagogical content knowledge and its relationship to the teachers' pedagogical beliefs. *The Asia-Pacific Education Researcher*, *22*(4), 657-666.

Chai, C. S., Koh, J. H. L., & Tsai, C. C. (2010). Facilitating preservice teachers' development of Technological, Pedagogical, and Content Knowledge (TPACK). *Educational Technology & Society, 13*(4), 63–73.

Chai, C. S., Koh, J. H. L., & Tsai, C. C. (2013). A review of technological pedagogical content knowledge. *Educational Technology & Society, 16*(2), 31-51.

Chai, C. S., Koh, J. H. L., & Tsai, C. C. (2016). A review of the quantitative measures of Technological Pedagogical Content Knowledge (TPACK). In M. C. Herring, M. J. Koehler, & P. Mishra (Eds.), *Handbook of Technological Pedagogical Content Knowledge (TPACK) for Educators, 2nd Edition* (pp. 87-106). London, UK: Routledge.

Chen, R. J. (2010). Investigating models for preservice teachers' use of technology to support student-centered learning. *Computers & Education, 55*, 32–42.

Chien, Y. T., Chang, C. Y., Yeh, T. K., & Chang, K. E. (2012). Engaging pre-service science teachers to act as active designers of technology integration: A MAGDAIRE framework. Teaching and Teacher Education, 28(4), 578–588.doi: 10.1016/j.tate.2011.12.005

Chiu, T. K., & Churchill, D. (2016). Adoption of mobile devices in teaching: Changes in teacher beliefs, attitudes and anxiety. *Interactive Learning Environments, 24*(2), 317–327.

Christensen, R. (2002). Effects of technology integration education on the attitudes of teachers and students. *Journal of Research on Technology in Education, 34*(4), 411–433.

Christensen, R., & Knezek, G. (2001). Profiling teacher stages of adoption for technology integration. *Computers in New Zealand Schools, 13*(3), 25–29.

Christensen, R., & Knezek, G. (2008). Self-report measures and findings for information technology attitudes and competencies. In J. Voogt & G. Knezek (Eds.) (2008), *International handbook of information technology in primary and secondary education* (pp. 349–365). New York: Springer.

Christensen, R., & Knezek, G. (2009). Construct validity for the teachers' attitudes toward computers questionnaire. *Journal of Computing in Teacher Education, 25*(4), 143–155.

Christensen, R., & Knezek, G. (2017). Validating the technology proficiency self-assessment for 21st century learning (TPSA C21) instrument. *Journal of Digital Learning in Teacher Education, 33*(1), 20–31. https://doi.org/10.1080/21532974.2016.1242391.

Christensen, R., & Knezek, G. (2018). Measuring teacher attitudes, competencies, and pedagogical practices in support of student learning and classroom technology integration. In J. Voogt, G. Knezek, R. Christensen, & K. Lai, (2018). Second Handbook of Information Technology in Primary and Secondary Education (pp. 357-374). NY: Springer. https://doi.org/10.1007/978-3-319-71054-9

Christodoulou, A. (n.d.) *e-TPCK*. Retrieved from: www.etpck.org .

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. Hillsdale, NJ: Erlbaum.

Cohen, L., Manion, L., & Morrison, K. (2000). *Research methods in education. Fifth edition*. London: Routledge.

Cohen, L., Manion, L., & Morrison, K. (2007). *Research methods in education. Sixth edition.* London: Routledge.

Conole, G., & Dyke, M. (2004). What are the affordances of information and communication technologies? *Research in Learning Technology, 12*(2), 113–124.

Conole, G., & Wills, S. (2013). Representing learning designs–making design explicit and shareable. *Educational Media International, 50*(1), 24–38.

Constitution of Cyprus, 1960. Retrieved from: http://www.kypros.org/Constitution/

Cope, B., & Kalantzis, M. (2009). Multiliteracies: New literacies, new learning. *Pedagogies: An International Journal, 4*(3), 164-195.

Cope, B., & Kalantzis, M. (Eds.) (2000). Multiliteracies*: Literacy learning and the design of social futures*. London: Routledge.

Cox, S., & Graham, C. R. (2009). Diagramming TPACK in practice: Using an elaborated model of the TPACK framework to analyze and depict teacher knowledge. *TechTrends, 53*(5), 60-69. doi: 10.1007/s11528-009-0327-1

Creswell, J. W., & Poth, C. N. (2017). *Qualitative Inquiry & Research Design. Choosing among five approaches. Fourth edition.* Newbury Park, CA: Sage.

Creswell, J. W., (2013). *Research design: Qualitative, quantitative and mixed methods approaches. Fourth Edition*. Los Angeles: Sage.

Crompton, H. (2015). Pre-service teachers' developing technological pedagogical content knowledge (TPACK) and beliefs on the use of technology in the K-12 mathematics classroom: A review of the literature. In C. Angeli & N. Valanides, N. (Eds.) (2015). *Technological Pedagogical Content Knowledge. Exploring, Developing, and Assessing TPCK* (pp. 239-250). NY: Springer.

Crompton, H., Burke, D., & Gregory, K. H. (2017). The use of mobile learning in PK-12 education: A systematic review. *Computers & Education, 110*, 51 –63. https://doi.org/10.1016/j.compedu.2017.03.013.

Cummings, C. (2014). Teacher Created Prescriptive Interactive Content (TCPIC), SAMR, and Modernizing Remediation in Social Science Education. *Journal of Social Studies Research* 014 Conference Proceedings, pp. 37–39.

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: A comparison of two theoretical models. *Management Science, 35*(8), 982–1003.

De Boer, H., & van Steen, J. (Eds.) (2006). *Science, Technology and Innovation in the Netherlands Policies, facts and figures 2006.* Joint publication by the Ministry of Economic Affairs and the Ministry of Education, Culture and Science. Retrieved from: https://www.cepal.org/iyd/noticias/pais/2/31502/PB_doc%5b1%5d.1.pdf

De Rossi (2015). Saperi pedagogico-metodologico-didattici. In L. Messina & M. De Rossi (Eds.), *Tecnologie, formazione e didattica* (pp. 117-148). Roma, IT: Carocci.

De Rossi (2018b). *Laboratorio di Metodologie e Tecnologie per la Didattica a. a. 2018-2019.* [Teaching material collected through observation]

De Rossi (2018a). *Methodologies, Didactics and Technologies for Teaching [Course Summary*]. Retrieved from: https://en.didattica.unipd.it/off/2018/CU/SU/IA1870/000ZZ/SFO2043316/N0

De Rossi, M., & Trevisan, O. (2018). Technological pedagogical content knowledge in the literature: how TPCK is defined and implemented in initial teacher education. *Italian Journal of Educational Technology,* 26(1), 7-23. doi: 10.17471/2499-4324/988

Dede, C. (2008). Theoretical perspectives influencing the use of Information Technology in teaching and learning. In J. Voogt & G. Knezek. (Eds.). *International Handbook of Information technology in Primary and Secondary Education* (pp. 43-62). NY: Springer. 10.1007/978-0-387-73315-9.

Dennen, V. P., Burner, K. J., & Cates, M. L. (2018). Information and Communication Technologies, and Learning Theories: Putting Pedagogy into Practice. In J. Voogt, G. Knezek, R. Christensen, & K. Lai, (2018). *Second Handbook of Information Technology in Primary and Secondary Education* (pp. 143-160). NY: Springer. DOI: https://doi.org/10.1007/978-3-319-71054-9.

Desimone, L. M. (2009). Improving impact studies of teachers' professional development: Toward better conceptualization and measures. *Educational Researcher, 38*(3), 181–199.

Doering, A., Scharber, C., Miller, C., & Veletsianos, G. (2009). Geothentic: designing and assessing with technological pedagogical content knowledge. *Contemporary Issues in Technology and Teacher Education, 9*(3), 316–336.

Drent, M., & Meelissen, M. (2008). Which factors obstruct or stimulate teacher educators to use ICT innovatively? *Computers & Education, 51*(1), 187–199

Dwyer, D. C., Ringstaff, C., Haymore, J., & Sandholtz, P. D. (1994). Apple classrooms of tomorrow. *Educational Leadership, 51*(7), 4–10.

Dyer, C. (1995) *Beginning Research in Psychology*. Oxford: Blackwell.

Ertmer, P. A. (1999). Addressing first- and second- order barriers to change: strategies for technology integration. *Educational Technology Research and Development, 47*(4), 47-61.

Ertmer, P. A. (2005). Teacher pedagogical beliefs: The final frontier in our quest for technology integration? *Educational Technology Research and Development, 53(*4), 25–39. http://dx.doi.org/10.1007/BF02504683

Ertmer, P. A., & Ottenbreit-Leftwich, A. T. (2010). Teacher technology change: How knowledge, confidence, beliefs, and culture intersect. *Journal of Research on Technology in Education, 42*(3), 255–284. doi:10.1080/15391523.2010.10782551

Ertmer, P. A., Ottenbreit-Leftwich, A., Sadik, O., Sendurur, E., & Sendurur, P. (2012). Teacher beliefs and technology integration practices: A critical relationship. *Computers & Education, 59*, 423–435. https://doi.org/10.1016/j.compedu.2012.02.001.

Farjon, D., Smits, A., & Voogt, J. (2019). Technology integration of pre-service teachers explained by attitudes and beliefs, competency, access, and experience. *Computers & Education, 130*, 81-93.

Feng, Y. & Hew, K. (2005). K-12 teachers' pedagogical reasoning in planning instruction with technology integration. In C. Crawford, R. Carlsen, I. Gibson, K. McFerrin, J. Price, R. Weber & D. Willis (Eds.), *Proceedings of SITE 2005—Society for Information Technology & Teacher Education International Conference* (pp. 3173-3180). Chesapeake, VA: Association for the Advancement of Computing in Education.

Figg, C, & Jaipal, K. (2012). TPACK-in-Practice: Developing 21st century teacher knowledge. In P. Resta (Ed.), *Proceedings of Society for Information Technology & Teacher Education International Conference 2012* (pp. 4683-4689). Chesapeake, VA: AACE.

Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention and behaviour: An introduction to theory and research*. Boston: Reading, Addison-Wesley.

Forkosh-Baruch, A. (2018). Preparing preservice teachers to transform education with Information and Communication Technologies. In J. Voogt, G. Knezek, R. Christensen, & K. Lai, (2018). *Second Handbook of Information Technology in Primary and Secondary Education* (pp. 415-432). NY: Springer. DOI: https://doi.org/10.1007/978-3-319-71054-9.

Gell, A. (1998). *Art and Agency. An Anthropological Theory.* Oxford: Oxford University Press.

Gencturk, E., Gokcek, T., & Gunes, G. (2010). Reliability and validity study of the technology proficiency self-assessment scale. *Procedia Social and Behavioral Sciences, 2*, 2863–2867.

Gess-Newsome, J. (2002). Pedagogical content knowledge: an introduction and orientation, in J. Gess-Newsome & N. Lederman (Eds.), *PCK and science education* (pp. 3-17). New York, NY: Kluwer Academic Publishers.

Gibson, J.J. (1999). *The ecological approach to visual perception.* Hillsdale: Lawrence Erlbaum Associates.

Graham, C. R. (2011). Theoretical considerations for understanding technological pedagogical content knowledge (TPACK). *Computers & Education, 57*(3), 1953-1956. doi: 10.1016/j.compedu.2011.04.010

Green, T. F. (1971). *The activities of teaching*. New York: McGraw-Hill

Gudmundsdöttir, S. (1988). Knowledge use among experienced teachers: Four case studies of high school teaching. *PhD Dissertation,* Stanford University.

Guerrero, S. (2010). Technological pedagogical content knowledge in the mathematics classroom. *Journal of Digital Learning in Teacher Education, 26*(4), 132-139. doi: 10.1080/10402454.2010.10784646

Gurcan-Namlu, A., & Ceyhan, E. (2003). Computer anxiety: multidimensional analysis on teacher candidates. *Educational Sciences: Theory and Practice, 3*(2), 401–432.

Guzey, S. S., & Roehrig, G. H. (2009). Teaching science with technology: case studies of science teachers' development of technology, pedagogy, and content knowledge. *Contemporary Issues in Technology and Teacher Education, 9*(1), 25–45.

Haines, K. (2015). Learning to identify and actualize affordances in a new tool. *Language Learning and Technology*, *19*(1), 165–180.

Hall, G. E. (1974). *The concerns-based adoption model: A developmental conceptualization of the adoption process within educational institutions*. Paper presented at the Annual Meeting of the American Educational Research Association, Chicago, IL.

Hall, G. E. (2010). Technology's Achilles heel: Achieving high-quality implementation. *Journal of Research on Technology in Education, 42*(3), 231–253.

Hall, G. E., Dirksen, D. J., George, A. A. (2006). *Measuring implementation in schools: Levels of use*. Retrieved from http://www.sedl.org/cbam/lou_manual_201410.pdf.

Hamilton, E. R., Roseberg, J. M., & Akcaoglu, M. (2016). The Substitution Augmentation Modification Redefinition (SAMR) Model: a critical review and suggestions for its use *TechTrends, 60,* 433-441. DOI 10.1007/s11528-016-0091-y

Hammond, T. C., & Manfra, M. (2009). Giving, prompting, making: Aligning technology and pedagogy within TPACK for social studies instruction. *Contemporary Issues in Technology and Teacher Education, 9*(2), 160-185.

Harris, J. B., & Hofer, M. J. (2009). Instructional planning activity-types as vehicles for curriculum-based TPACK development. In C. D. Maddux (Ed.) (2009). *Research highlights in technology and teacher education*, pp. 99-108. Chesapeake, VA: Society for Information Technology.

Harris, J. B., & Hofer, M. J. (2011). Technological pedagogical content knowledge (TPACK) in action: A descriptive study of secondary teachers' curriculum-based, technology-related instructional planning. *Journal of Research on Technology in Education, 43*(3), 211-229. doi: 10.1080/15391523.2011.10782570

Harris, J. B., Mishra, P., & Koehler, M. (2009). Teachers' technological pedagogical content knowledge: Curriculum-based technology integration reframed. *Journal of Research on Technology in Education, 41*(4), 393-416

Harris, J., & Phillips, M. (2018). If There's TPACK, is There Technological Pedagogical Reasoning and Action? *Proceedings of Society for Information Technology & Teacher Education International Conference (2018) Washington D.C.* (pp. 2051 - 2061). Chesapeake, VA: Association for the Advancement of Computing in Education.

Harris, J., Grandgenett, N., & Hofer, M. (2010). Testing a TPACK-based technology integration assessment rubric. In C.D. Maddux, D. Gibson & B. Dodge (Eds.), *Research highlights in technology and teacher education 2010* (pp. 323-331). Chesapeake, VA: Society for information Technology in Teacher Education.

Harris, J., Phillips, M., Koehler, M. & Rosenberg, J. (2017). TPCK/TPACK research and development: Past, present, and future directions. *Australasian Journal of Educational Technology, 33*(3), i-viii. https://doi.org/10.14742/ajet.3907

Harris, J., Phillips, M., Koehler, M., & Rosenberg, J. (2017). TPCK/TPACK research and development: Past, present and future directions. *Australasian Journal of Educational Technology AJET, 33*(3), i-viii.

Hart, S. A., & Laher, S. (2015). Perceived usefulness and culture as predictors of teachers attitudes towards educational technology in South Africa. *South African Journal of Education, 35*(4), 1–12.

Hattie, J. (2009). *Visible Learning*. London: Routledge.

Hazzan, O. (2003). Prospective high school mathematics teachers' attitudes toward integrating computers in their future teaching. *Journal of Research on Technology in Education, 35*, 213–246.

Heitink, M., Voogt, J., Fisser, P., Verplanken, L., & van Braak, J. (2017). Eliciting teachers' technological pedagogical knowledge. *Australasian Journal of Education Technology, 33*(3), 96–109.

Heitink, M., Voogt, J., Verplanken, L., Van Braak, J., & Fisser, P. (2016). Teachers' professional reasoning about their pedagogical use of technology. *Computers and Education*, *101*, 70–83. http://doi.org/10.1016/j.compedu.2016.05.009

Herring, M. C., Koehler, M. J., & Mishra, P. (2016). *Handbook of Technological Pedagogical Content Knowledge (TPACK) for Educators, 2nd Edition.* London: Routledge.

Hew, K. F., & Brush, T. (2007). Integrating technology into K-12 teaching and learning: Current knowledge gaps and recommendations for future research. *Educational Technology Research and Development, 55*(3), 223–252.

Hilton, J. T. (2016). A case study of the Application of SAMR and TPACK for Reflection on Technology integration into Two Social Studies classrooms. *The Social Studies, 107*(2), 68-73 DOI https://doi.org/10.1080/00377996.2015.1124376.

Hofer, M., & Grandgenett, N. (2012). TPACK development in teacher education: A longitudinal study of pre-service teachers in a secondary M.A.Ed. Program. *Journal of Research on Technology in Education, 45*(1), 83-106. doi: 10.1080/15391523.2012.10782598

Home Affairs and Kingdom Relations (n.d.). *Constitution for The Kingdom of The Netherlands*. Retrieved from: https://wetten.overheid.nl/BWBR0001840/2018-12-21

Howard, S. K., & Gigliotti, A. (2016). Having a go: Looking at teachers' experience of risk-taking in technology integration. *Education and Information Technologies, 21*(5), 1351–1366. https://doi.org/10.1007/s10639-015-9386-4.

Howland, J. L. M., Jonassen, D., & Marra, R. M. (2012). *Meaningful Learning With Technology. Fourth Edition*. Pearson.

Hsu, C. Y., Liang, J. C., Chai, C. S., & Tsai, C. C. (2013). Exploring preschool teachers' technological pedagogical content knowledge of educational games. *Journal of Educational Computing Research, 49*(4), 461-479. doi:10.2190/EC.49.4.c

Hunter, J. (2015). *Technology integration and high possibility classrooms*. *Building from TPACK*. New York: Routledge.

Hutchby, I. (2001). Technologies, texts and affordances. *Sociology, 35*(2), 441–456.

IBM (n.d.). *Clustering Principles.* Retrievable at: https://www.ibm.com/support/knowledgecenter/en/SSLVMB_24.0.0/spss/tutorials/twostep_methodology.html

Ihde, D. (1993). *Philosophy of technology. An introduction*. New York: Paragon House.

Inan, F. A., & Lowther, D. L. (2010a). Factors affecting technology integration in K-12 classrooms: A path model. *Educational Technology Research and Development, 58*, 137–154. https://doi.org/10.1007/s11423-009-9132-y.

Inan, F. A., & Lowther, D. L. (2010b). Laptops in the K-12 classrooms: Exploring factors impacting instructional use. *Computers & Education, 55*(3), 937–944. https://doi.org/10.1016/j.compedu.2010.04.004.

Ioannou, I. (2016). *Technological pedagogical content knowledge as a framework for the teaching of computer science: Strengths and weaknesses*. Doctoral dissertation, University of Cyprus.

Jaipal, K., & Figg, C. (2010). Expanding the practice-based taxonomy of characteristics of TPACK. In C. Crawford et al. (Eds.), *Proceedings of society for information technology & teacher education international conference* (pp. 3868-3875). Chesapeake, VA: AACE.

Jaipal-Jamani, K., & Figg, C. (2015). The framework of TPACK – in – Practice: Designing content-centric technology professional learning contexts to develop teacher knowledge of technology-enhanced teaching (TPACK). In C. Angeli & N. Valanides (Eds.), *Technological pedagogical content knowledge. Exploring, developing, and assessing TPCK* (pp. 137-163). New York, NY: Springer.

James, M. C., & Scharmann, L. C. (2007). Using analogies to improve the teaching performance of preservice teachers. Journal of Research in Science Teaching, 44 (4), 565–585.

Jang, S. J., & Tsai, M. F. (2012). Exploring the TPACK of Taiwanese elementary mathematics and science teachers with respect to use of interactive whiteboards. *Computers & Education, 59*(2), 327-338. doi:10.1016/j.compedu.2012.02.003

Jick, T. D. (1979). Mixing qualitative and quantitative methods: Triangulation in action. *Administrative Science Quarterly*, 24, 602-611.

Jimoyannis, A. (2010). Designing and implementing an integrated technological pedagogical science knowledge framework for science teachers' professional development. *Computers & Education, 55*(3), 1259–1269. doi:10.1016/j.compedu.2010.05.022

Jonassen, D., Peck, K., & Wilson, B. (2000). *Learning with technology: A constructivist approach*. Upper Saddle River, NJ: Prentice Hall.

Joo, Y. J., Lee, H. W., & Ham, Y. (2014). Integrating user interface and personal innovativeness into the TAM for mobile learning in Cyber University. *Journal of Computing in Higher Education, 26(*2), 143-158.

Joo, Y. J., Park, S., & Lim, E. (2018). Factors Influencing Preservice Teachers' Intention to Use Technology: TPACK, Teacher Self-efficacy, and Technology Acceptance Model. *Educational Technology & Society, 21*(3), 48–59.

Judson, E. (2006). How teachers integrate technology and their beliefs about learning: Is there a connection? *Journal of Technology and Teacher Education, 14*, 581–597.

Kalantzis, M., & Cope, B. (2012). *Literacies*. Cambridge: Cambridge University Press.

Karaca, F., Can, G., & Yildirim, S. (2013). A path model for technology integration into elementary school settings in Turkey. *Computers & Education, 68*, 353–365. https://doi.org/10.1016/j.compedu.2013.05.017.

Kavanoz, S., Yuksel, H., & Ozcan. E. (2015) Pre-service teachers' self-efficacy perceptions on WEB pedagogical content knowledge. *Computers & Education, 85,* 94–101. https://doi.org/10.1016/j.compedu.2015.02.005.

Kazu, I. Y., & Erten, P. (2014). Teachers' technological pedagogical content knowledge self-efficacies. *Journal of Education and Training Studies, 2*(2), 126–144.

Kebritchi, M., & Hirumi, A. C. (2008). Examining the pedagogical foundations of modern educational computer games. *Computers & Education, 51*(4), 1729–1743. https://doi.org/10.1016/j.compedu.2008.05.004

Kennisnet. (2012). *Vier in balans monitor 2012. ICT in het onderwijs: de stand van zaken [Four in balance monitor 2012. ICT in education: progress*]. Zoetermeer: Kennisnet. Retrieved from http://archief.kennisnet.nl/fileadmin/contentelementen/kennisnet/Bestanden_Hans/vierinbalans2012_01.pdf.

Khan, S. (2011). New pedagogies on teaching science with computer simulations. *Journal of Science Education & Technology, 20*(3), 215-232. doi: 10.1007/s10956-010-9247-2

Kim, C. M., Kim, M. K., Lee, C., Spector, J. M., & De Meester, K. (2013). Teacher beliefs and technology integration. *Teaching and Teacher Education, 29*(1), 76–85.

Kim, S. (2016). *Relationships between preservice secondary mathematics teachers' beliefs, knowledge, and technology use* (Doctoral dissertation, University of Georgia). Retrieved from https://getd.libs.uga.edu/pdfs/kim_somin_201605_phd.pdf

Kimmons, R., & Hall, C. (2016). Toward a broader understanding of teacher technology integration beliefs and values. *Journal of Technology and Teacher Education, 24*(3), 309–335.

Kiran, A. H., & Verbeek, P. P. (2010). Trusting Our Selves to Technology. Knowledge*, Technology & Policy, 23*, 409-427.

Knezek, G., & Christensen, R. (2008). The importance of information technology attitudes and competencies in primary and secondary education. In J. Voogt, & G. Knezek (Eds.). *International handbook of information technology in primary and secondary education* (pp. 321–331). New York: Springer.

Knezek, G., & Christensen, R. (2016). Extending the will, skill, tool model of technology integration: Adding pedagogy as a new model construct. *Journal of Computing in Higher Education, 28*(3), 307–325.

Knezek, G., & Christensen, R. (2018). The evolving role of attitudes and competencies in Information and Communication Technology in education. In J. Voogt, G. Knezek, R. Christensen, & K. Lai, (2018). *Second Handbook of Information Technology in Primary and Secondary Education* (pp. 239-254). NY: Springer. DOI: https://doi.org/10.1007/978-3-319-71054-9

Koehler , M. J, Mishra, P., & Yahya, K. (2007). Tracing the development of teacher knowledge in a design seminar: integrating content, pedagogy and technology. *Computers & Education, 49*(3), 740-762.

Koehler, M. J., & Mishra, P. (2005a). Teachers learning technology by design. *Journal of Computing in Teacher Education, 21*(3), 94-101. doi: 10.1080/10402454.2005.10784518

Koehler, M. J., & Mishra, P. (2005b). What happens when teachers design educational technology? The development technological pedagogical content knowledge. *Journal of Educational Computing Research, 32*(2), 131-152. doi: 10.2190/0EW7-01WB-BKHL-QDYV

Koehler, M. J., Mishra, P., Bouck, E. C., DeSchryver, M., Kereluik, K., Shin, T. S., & Wolf, L. G. (2011). Deep-play: developing TPACK for 21st century teachers. International *Journal of Learning Technology, 6(*2), 146-163. https://doi.org/10.1504/IJLT.2011.042646

Koehler, M., & Mishra, P. (2008). Introducing TPCK. In AACTE Committee on Innovation and Technology (Eds.), *The handbook of technological pedagogical content knowledge (TPCK) for educators* (pp. 3-29). New York, NY: American Association of Colleges of Teacher Education and Routledge.

Koehler, M., & Mishra, P. (2009). What is technological pedagogical content knowledge (TPACK)? *Contemporary Issues in Technology and Teacher Education, 9*(1), 60–70

Koehler, M., Mishra, P., Akcaoglu, M. & Rosenberg, J. (2016). The Technological Pedagogical Content Knowledge Framework for Teachers and Teacher Educators. In M.R., Panigrahi (Ed.). *Resource Book on ICT Integrated Teacher Education*. New Delhi: Commonwealth Educational Media Centre for Asia.

Koh, J. H. L, & Chai, C. S. (2014). Teacher clusters and their perceptions of technological pedagogical content knowledge (TPACK) development through ICT lesson design. *Computers & Education, 70*, 222-232. doi:10.1016/j.compedu.2013.08.017

Koh, J. H. L. (2013). A rubric for assessing teachers' lesson activities with respect to TPACK for meaningful learning with ICT. *Australasian Journal of Educational Technology, 29*(6), 887-900. doi: 10.14742/ajet.228

Koh, J. H. L., & Divaharan, S. (2011). Developing pre-service teachers' technology integration expertise through the TPACK-developing instructional model. *Journal of Educational Computing Research, 44*(1), 35-58. doi:10.2190/EC.44.1.c

Koh, J., & Frick, T. (2009). Instructor and student classroom interactions during technology skills instruction for facilitating preservice teachers' computer self-efficacy. *Journal of Educational Computing Research, 40*, 221–228.

Kopcha, T. J., & Sullivan, H. (2007). Self-presentation bias in surveys of teachers' educational technology practices. *Educational Technology Research and Development, 55*(6), 627–646.

Kramarski, B., & Michalsky, T. (2009). Three metacognitive approaches to training pre-service teachers in different learning phases of technological pedagogical content knowledge. *Educational Research and Evaluation, 15*(5), 465-485.

Kramarski, B., & Michalsky, T. (2010). Preparing preservice teachers for self-regulated learning in the context of technological pedagogical content knowledge. *Learning and Instruction, 20*(5), 434-447. doi:10.1016/j.learninstruc.2009.05.003

Kramarski, B., & Michalsky, T. (2015). Effect of a TPACK-SRL model on teachers' pedagogical beliefs, self-efficacy, and technology-based lesson design. In C. Angeli, & N. Valanides (Eds.), *Technological pedagogical content knowledge. Exploring, developing, and assessing TPCK* (pp. 89-112). New York, NY: Springer.

Krauskopf, K., Zahn, C., & Hesse, F. W. (2012). Leveraging the affordances of YouTube: The role of pedagogical knowledge and mental models of technology functions for lesson planning with technology. *Computers & Education, 58*(4), 1194-1206. doi: 10.1016/j.compedu.2011.12.010

Krauskopf, K., Zahn, C., & Hesse, F. W. (2015). Cognitive processes underlying TPCK: Mental models, cognitive transformation, and meta-conceptual awareness. In C. Angeli & N. Valanides (Eds.), *Technological pedagogical content knowledge. Exploring, developing, and assessing TPCK* (pp.41-61). New York, NY: Springer.

Krischner, P. A. (2017). Stop propagating the learning styles myth. *Computers & Education, 106,* 166-171. http://dx.doi.org/10.1016/j.compedu.2016.12.006

Kruskal, J.B. & Wish, M. (1978) *Multidimensional Scaling*. London: Sage.

Kyriakides, L. (n.d.). *Welcome message. UCY Department of Educational Sciences*. Retrieved from: http://www.ucy.ac.cy/edu/el/welcome-message.

Lambert, J., Gong, Y., & Cuper, P. (2008). Technology, transfer and teaching: The impact of a single technology course on preservice teachers' computer attitudes and ability. *Journal of Technology and Teacher Education, 16*(4), 385–410

Laurillard, D. (2012). *Teaching as a design science. Building pedagogical patterns for learning and teaching*. New York: Routledge.

Leatham, K. R. (2006). Viewing mathematics teachers' beliefs as sensible systems. *Journal of Mathematics Teacher Education, 9*(1), 91-102.

Lee, M. H., & Tsai, C. C. (2010). Exploring teachers' perceived self-efficacy and technological pedagogical content knowledge with respect to educational use of the World Wide Web. *Instructional Science, 38*(1), 1-21. doi:10.1007/s11251-008-9075-4

Lee, Y., & Lee, J. (2014). Enhancing pre-service teachers' self-efficacy beliefs for technology integration through lesson planning practice. *Computers & Education, 73*, 121–128.

Leng, N. W. (2011). Reliability and validity of an information and communications technology attitude scale for teachers. *The Asia-Pacific Education Researcher, 20*(1), 162–170.

Lenhard, W. & Lenhard, A. (2016). *Calculation of Effect Sizes.* Retrieved from: https://www.psychometrica.de/effect_size.html. Dettelbach (Germany): Psychometrica. DOI: 10.13140/RG.2.2.17823.92329

Levin, T., & Wadmany, R. (2008). Teachers' views on factors affecting affective integration of information technology in the classroom: Developmental scenery. *Journal of Technology and Teacher Education, 16*(2), 233–263.

Lim, C. P., & Chan, B. C. (2007). MicroLESSONS in teacher education: Examining pre-service teachers' pedagogical beliefs. *Computers & Education, 48*(3), 474–494.

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry.* Beverly Hills, CA: Sage.

Lisbon Recognition Convention, 1997. (*Convention on the Recognition of Qualifications concerning Higher Education in the European Region*). Retrieved from: https://www.coe.int/en/web/conventions/full-list/-/conventions/treaty/165

Liu, S. H. (2011). Factors related to pedagogical beliefs of teachers and technology integration. *Computers & Education, 56*(4), 1012–1022.

Loughran, J., Keast, S., & Cooper, R. (2016). Pedagogical Reasoning in Teacher Education. In *International Handbook of Teacher Education* (pp. 387-421). Springer Singapore.

MacCallum, K., Day, S., Skelton, D., & Verhaart, M. (2017). Mobile Affordances and Learning Theories in Supporting and Enhancing Learning. *International Journal of Mobile and Blended Learning, 9*(2), 61-73.

Madigan, E.M., Goodfellow, M., Stone, J.A. (2007). Gender, perceptions, and reality: technological literacy among first-year students. SIGCSE *Proceedings of the 38th SIGCSE technical symposium on Computer science education*, pp. 410-414. Covington, Kentucky, 7-11/03/2007. doi>10.1145/1227310.1227453

Mathipa, E. R., & Mukhari, S. (2014). Teacher factors influencing the use of ICT in teaching and learning in South African urban schools. *Mediterranean Journal of Social Sciences, 5*(23), 1213.

Mayer, R. E. (2009). *Multimedia learning (2nd ed.).* New York: Cambridge University Press.

McDonald, J. K., Yanchar, S. C., & Osguthorpe, R. T. (2005). Learning from programmed instruction: Examining implications for modern instructional technology. *Educational Technology Research and Development, 53*(2), 84–98. https://doi.org/10.1007/bf02504867

McGrenere, J., & Ho, W. (2000). Affordances: Clarifying and evolving a concept. In *Proceedings of Graphics Interface 2000* (pp.179-186). Montreal: Canadian Human-Computer Communications Society. 10.20380/GI2000.24

McKenney, S., Kali, Y., Markausikaite, L., & Voogt, J. (2015). Teacher design knowledge for technology enhanced learning: an ecological framework for investigating assets and needs. *Instructional Science, 43,* 181-202.

Meredith, A. (1995). Terry's Learning: Some limitations of Shulman's pedagogical content knowledge. *Cambridge Journal of Education, 25*(2), 175 – 187.

Merton, R. K. & Kendall, P. L. (1946) The focused interview. *American Journal of Sociology, 51*, 541-557.

Messina, L. (2015), Integrare i saperi di base. In L. Messina & M. De Rossi (Eds.), *Tecnologie, formazione e didattica* (pp. 187-216). Roma, IT: Carocci.

Messina, L., & De Rossi, M. (2015) *Tecnologie, formazione e didattica*. Roma, IT: Carocci.

Messina, L., & De Rossi, M. (2017). *Presentation of the design procedure* [Material shared with academic University staff]

Messina, L., & Tabone, S. (2015). Training kindergarten and primary education student teachers to plan learning units combining TPACK, LAT and multimodality. In E. de la Poza, J. Domènech, J. Lloret, M. C. Vincent Vela & E. Zuriaga Agustí (Eds.), *HEAd' 15. 1st Conference on Higher Education Advances* (pp. 349-356). Valencia: Editorial Universitat Politècnica de València.

Messina, L., De Rossi, M., Tabone, S., & Tonegato, P. (2018). Instructional planning and new technologies in teacher education: the initial phase of a research project. *Italian Journal of Educational Technology, 26* (1), 56-70. Doi: 10.17471/2499-4324/992

Messina, L., De Rossi, M., Tabone, S., & Tonegato, P. (2016). *Dimensioni determinanti per integrare le tecnologie nella progettazione didattica*. Paper Presented at Multiconference EMEM 2016 "Design the future", Università degli Studi di Modena, Modena, 7-9 settembre 2016.

Miles, M. B., Huberman, A. M., & Saldana, J. (2014). *Qualitative Data Analysis. A Methods Sourcebook*. Los Angeles: Sage.

Milman, N., & Molebash, P. E. (2008). A longitudinal assessment of teacher education students' confidence toward using technology. *Journal of Educational Computing Research, 38*(2), 183–200.

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: a framework for integrating technology in teacher knowledge. *Teachers college record, 108* (6), 1017-1054. http://dx.doi.org/10.1111/j.1467-9620.2006.00684.x

Mishra, P., Peruski, L., & Koehler, M. (2007). Developing technological pedagogical content knowledge (TPCK) through teaching online. In R. Carlsen et al. (Eds.), *Proceedings of Society for Information Technology & Teacher Education International Conference 2007* (pp. 2208-2213). Chesapeake, VA: Association for the Advancement of Computing in Education (AACE).

Morrison, K. R. B. (1993) *Planning and Accomplishing School-Centred Evaluation*. Dereham, UK: Peter Francis.

Mouza, C. (2016). Developing and assessing TPACK among pre-service teachers: A synthesis of research. In M. C. Herring, M. J. Koehler, & P. Mishra (Eds.), *Handbook of Technological Pedagogical Content Knowledge (TPACK) for Educators, 2nd Edition* (pp. 169-190). London, UK: Routledge.

Mouza, C., & Karchmer-Klein, R. (2013). Promoting and assessing pre-service teachers' pedagogical content knowledge (TPACK) in the context of case development. *Journal of Educational Computing Research, 48*(2), 127-152. doi: 10.2190/EC.48.2.b

Mouza, C., & Wong, W. (2009). Studying classroom practice: case development for professional learning in technology integration. *Journal of Technology and Teacher Education, 17*(2), 175–202.

Mouza, C., Karchmer-Klein, R., Nandakumar, R., Yilmaz Ozden, S., & Hu, L. (2014). Investigating the impact of an integrated approach to the development of preservice teachers' technological pedagogical content knowledge (TPACK). *Computers & Education, 71*, 206–221. doi: 10.1016/j.compedu.2013.09.020

Mouza, C., Nabdakumar, R., Yilmaz Ozden, S., & Karchmer-Klein, R. (2015). A longitudinal investigation of pre-service teachers' technological pedagogical content knowledge (TPACK) in the context of a teacher preparation program. Paper presented at the *Annual Meeting of the American Educational Research Association* (pp. 153-171). Chicago, IL, April. doi: 10.1080/01626620.2016.1248301

Moyles, J. (2002) Observation as a research tool. In M. Coleman and A. J. Briggs (eds) *Research Methods in Educational Leadership,* pp. 172-191. London: Paul Chapman.

Niederhauser, D. S., & Lindstrom, D. L. (2018). Instructional Technology integration models and frameworks: Diffusion, competencies, attitudes and dispositions. In J. Voogt, G. Knezek, R. Christensen, & K. Lai, (2018). *Second Handbook of Information Technology in Primary and Secondary Education* (pp. 335-356). NY: Springer. DOI: https://doi.org/10.1007/978-3-319-71054-9

Niederhauser, D. S., & Perkmen, S. (2008). Validation of the intrapersonal technology integration scale: Assessing the influence of intrapersonal factors that influence technology integration. *Computers in The Schools, 25*(1-2), 98-111.

Niederhauser, D. S., & Stoddart, T. (2001). Teachers' instructional perspectives and use of educational software. *Teaching and Teacher Education, 17*(1), 15–31.

Niess, M. L. (2005). Preparing teachers to teach science and mathematics with technology: developing a technology pedagogical content knowledge. *Teaching and Teacher Education, 21(5*), 509-523. doi:10.1016/j.tate.2005.03.006

Niess, M. L. (2011). Investigating TPACK: Knowledge growth in teaching with technology. *Journal of Educational Computing Research, 44*(3), 299-317.

Niess, M. L. (2015). Transforming teachers' knowledge: Learning trajectories for advancing teacher education for teaching with technology. In C. Angeli & N. Valanides (Eds.), *Technological pedagogical content knowledge. Exploring, developing, and assessing TPCK* (pp. 19-37). New York, NY: Springer.

Niess, M. L., & Gillow-Wiles, H. (2013). Developing asynchronous online courses: Key instructional strategies in a social metacognitive constructivist learning trajectory. *The Journal of Distance Education, 27*(1), 1-23.

Niess, M., & Gillow-Wiles, H. (2017). Expanding teachers' technological pedagogical reasoning with a systems pedagogical approach. *Australasian Journal of Educational Technology, 33*(3), 77-95. doi:10.14742/ajet.3473

Nilsson, P. (2009). From lesson plan to new comprehension: exploring student teachers' pedagogical reasoning in learning about teaching, *European Journal of Teacher Education, 32*(3), 239-258.

Nisbet, J. & Watt, J. (1984) Case study. In J. Bell, T. Bush, A. Fox, J. Goodey & S. Goulding (Eds). *Conducting Small-Scale Investigations in Educational Management,* 79-92. London: Harper & Row.

Nunnally, J. (1978). *Psychometric theory (2nd ed.).* New York, NY: McGraw-Hill.

Nunnally, B. H. & Bernstein, J. C. (1994). *Psychometric theory.* London, UK: McGraw-Hill.

Ottenbreit-Leftwich, A. T., Glazewski, K. D., Newby, T. J., & Ertmer, P. A. (2010). Teacher value beliefs associated with using technology: Addressing professional and student needs. *Computers & Education, 55*(3), 1321–1335. https://doi.org/10.1016/j.compedu.2010.06.002.

Ottenbreit-Leftwich, A. T., Kopcha, T. J., & Ertmer, P. A. (2018). Information and Communication Technology dispositional factors and relationship to Information and Communication Technology practices. In J. Voogt, G. Knezek, R. Christensen, & K. Lai, (2018). *Second Handbook of Information Technology in Primary and Secondary Education* (pp. 309-334). NY: Springer. DOI: https://doi.org/10.1007/978-3-319-71054-9.

Overbay, A., Patterson, A., Vasu, E., & Grable, L. (2010). Constructivism and technology use: Findings from the impacting leadership project. *Educational Media International, 47*(2), 103–120.

Ozgün-Koca, S. A. (2009). The views of pre-service teachers about the strengths and limitations of the use of graphing calculators in mathematics instruction. *Journal of Technology and Teacher Education, 17*(2), 203-227.

Pajares, F. (2002). Gender and Perceived Self-Efficacy in Self-Regulated Learning. *Theory Into Practice, 41*(2), 116-125. 10.1207/s15430421tip4102_8

Pajares, F., & Schunk, D. H. (2002). Self and self-belief in psychology and education: A historical perspective. In J. Aronson (Ed.), *Improving academic achievement: Impact of psychological factors on education* (pp. 3–21). New York: Academic Press.

Pamuk, S., & Peker, D. (2009). Turkish pre-service science and mathematics teachers' computer related self-efficacies, attitudes, and the relationship between these variables. *Computers & Education, 53*(2), 454–461.

Papanastasiou, E. C., & Angeli, C. (2008). Evaluating the Use of ICT in Education: Psychometric Properties of the Survey of Factors Affecting Teachers Teaching with Technology (SFA-T3). *Educational Technology & Society, 11* (1), 69-86.

Papanikolaou, K., Gouli, E., & Makri, K. (2014). Designing pre-service teacher training based on a combination of TPACK and communities of inquiry. *Procedia- Social and Behavioral Sciences, 116,* 3437-3442.

Patton, M. Q. (1990). *Qualitative Evaluation and Research Methods (second edition).* London: Sage.

Pea, R. D. (1993). Practices of distributed intelligence and designs for education. In G. Salomon (Ed.), *Distributed cognitions: Psychological and educational considerations,* pp. 47-87. Cambridge University Press.

Perkman, S., & Pamuk, S. (2011). Social cognitive predictors of pre-service teachers' technology integration performance. *Asia Pacific Education Review, 12*(1), 45–58.

Peterson, R., & Treagust, D. F. (1992). Primary pre-service teachers' pedagogical reasoning skills. *Research in Science Education, 22* (1), 323–330.

Peterson, R., & Treagust, D. F. (1995). Developing preservice teachers' pedagogical reasoning ability. *Research in Science Education, 25*(3), 291–305.

Peterson, R., & Treagust, D. F. (1998). Learning to teach primary science through problem-based learning. *Science Education, 82* (2), 215–237.

Petko, D. (2012). Teachers' pedagogical beliefs and their use of digital media in classrooms: Sharpening the focus of the "will, skill, tool" model and integrating teachers' constructivist orientations. *Computers & Education, 58*(4), 1351–1359. https://doi.org/10.1016/j.compedu.2011.12.013.

Pintrich, P. R., & Schunk, D. (2001). *Motivation in education: Theory, research and applications* (2nd ed.). New York: Pearson.

Prensky, M. (2005). "Engage Me or Enrage Me" What today's learners demand. *EDUCAUSE Review, Sept./Oct.*, 60-64.

Prestridge, S. J. (2012). The beliefs behind the teacher that influences their ICT practices. *Computers & Education, 58*, 449–458.

Puentedura, R. (2006). *Transformation, technology, and education*. Retrieved from http://hippasus.com/resources/tte/.

Puentedura, R. R. (2012). *The SAMR model: Background and exemplars*. Retrieved from http://www.hippasus.com/rrpweblog/archives/2012/08/23/SAMR_BackgroundExemplars.pdf

Punye, Y. (ed)., Redecker, C. (2017). *European Framework for the Digital Competence of Educators: DigCompEdu.* Luxembourg: Publications office of the European Union. doi:10.2760/159770-JRC107466

Richardson, K. W. (2009). *Looking at/looking through: Teachers planning for curriculum-based learning with technology* (Doctoral dissertation). Available from ProQuest Dissertations and Theses database. (UMI No. 3371354)

Rizhaupt, A. D., Huggins-Manley, A. C., Dawson, K., Agadi-Dogan, N., & Dogan, S. (2017). Validity and appropriate uses of the revised technology and perceptions survey (TUPS). *Journal of Research on Technology in Education, 49*(1-2), 73–87.

Robson, C. (2002). *Real World Research: A Resource for Social Scientists and Practitioner Researchers*. Oxford: Blackwell.

Roehrig, G. H., Kruse, R. A., & Kern, A. (2007). Teacher and school characteristics and their influence on curriculum implementation. *Journal of Research in Science Teaching, 44*, 883–907.

Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). New York: Simon & Schuster.

Romrell, D., Kidder, L. C., & Wood, E. (2014). The SAMR Model as Framework for Evaluating mLearning. *Journal of Asynchronous Learning Networks*, *18*(2), 1-15.

Rosenberg, J. & Koehler, M. (2014). Context and Technological Pedagogical Content Knowledge: A Content Analysis. In M. Searson & M. Ochoa (Eds.), *Proceedings of SITE 2014--Society for Information Technology & Teacher Education International Conference* (pp. 2626-2631). Jacksonville, Florida, United States: Association for the Advancement of Computing in Education (AACE).

Rossman, G. B., & Wilson, B. L. (1985). Numbers and words: Combining quantitative and qualitative methods in a single large-scale evaluation study. *Evaluation Review, 9*(5), 627-643.

Roushias, C., & Mardagijs, E. (2011). *Cyprus. Country Report on ICT in Education*. Retrieved from: http://insight.eun.org.

Roushias, C., & Mardagijs, E. (2011). *Cyprus. Country Report on ICT in Education*. Retrieved from: http://insight.eun.org.

Sang, G., Valcke, M., van Braak, J., & Tondeur, J. (2010). Student teachers’ thinking processes and ICT integration: Predictors of prospective teaching behaviors with educational technology. *Computers & Education, 54*(1), 103–112.

Sang, G., Valcke, M., van Braak, J., Tondeur, J., Chang, Z. & Yu, K. (2012). Challenging science teachers' beliefs and practices through a video-case-based intervention in China's primary schools. *Asia-Pacific Journal of Teacher Education, 40*(4), 363-378. https://doi.org/10.1080/1359866X.2012.724655

Scherer, R., Siddiq, F., & Teo, T. (2015). Becoming more specific: Measuring and modeling teachers' perceived usefulness of ICT in the context of teaching and learning. *Computers & Education, 88,* 202–214. https://doi.org/10.1016/j.compedu.2015.05.005.

Scherer, R., Tondeur, J., Siddiq, F., & Baran, E. (2018). The importance of attitudes toward technology for pre-service teachers' technological, pedagogical, and content knowledge (TPACK): Comparing structural equation modelling approaches. *Computers in Human Behavior, 80*, 67–80.

Schmidt, D. A., Baran, E., Thompson, A. D., Mishra, P., Koehler, M. J., & Shin, T. S. (2009). Technological pedagogical content knowledge (TPACK) the development and validation of an assessment instrument for preservice teachers. *Journal of Research on Technology in Education, 42*(2), 123-149. doi:10.1080/15391523.2009.10782544

Schön, D. A. (1983). The reflective practitioner: How professionals think in action. New York: Basic Books.

Schön, D. A. (1987). *Educating the reflective practitioner: Toward a new design for teaching and learning in the professions*. San Francisco, CA: Jossey-Bass.

Semiz, K., & Ince, L. I. (2012). Pre-service physical education teachers' technological pedagogical content knowledge, technology integration self-efficacy and instructional technology outcome expectations. *Australasian Journal of Educational Technology, 28*(7), 1248–1265.

Shaffer, D. W., Collier, W., & Ruis, A. R. (2016). A tutorial on Epistemic Network Analysis: Analyzing the structure of connections in cognitive, social, and interaction data. *Journal of Learning Analytics, 3* (3), 9-49. dx.doi.org/10.18608/jla.2016.33.3

Shaffer, D.W. (2017). *Quantitative Ethnography*. Madison, WI: Cathcart Press.

Shaughnessy, J. J., Zechmeister, E. B. & Zechmeister, J. S. (2003*) Research Methods in Psychology (sixth edition)*. New York: McGraw-Hill.

Shifflet, R., & Weilbacher, G. (2015). Teacher beliefs and their influence on technology use: A case study. *Contemporary Issues in Technology and Teacher Education, 15*(3), 368–394.

Shulman, L. (2015). PCK: Its genesis and exodus. In A. Berry, P. Friedrichsen, & J. Loughran (Eds.), *Re-examining Pedagogical Content Knowledge in Science Education* (pp. 3-13). Rotterdam, The Netherlands: Sense Publishers.

Shulman, L. S. (1986). Paradigms and research programs for the study of teaching. In M. C. Wittrock (Ed.), *Handbook of Research on Teaching (3rd ed.)* (pp. 3-36). New York, NY: Macmillan.

Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. H*arvard Educational Review, 57*(1), 1-23. doi: 10.17763/haer.57.1.j463w79r56455411

Shulman, L., & Sykes, G. (1986). *A National Board of Teaching? In Search of a Bold Standard.* Paper prepared for the *Task Force on Teaching as a Profession*. Washington, D.C.: Carnegie Forum on Education and the Economy.

Siemens, G. (2005). Connectivism: A learning *theory* for the digital age. *International Journal of Instructional Technology & Distance Learning, 2*(1). Retrieved from http://itdl.org/journal/jan_05/article01.htm

Siemens, G. (2006). *Knowing knowledge*. Vancouver, BC: Lulu.

Siemens, G. (2008). Learning and knowing in networks: Changing roles for educators and designers. *ITFORUM for Discussion,1.*

Singletary, L. M. (2012). *Mathematical Connections Made in Practice: An Examination of Teachers' Beliefs and Practices*. (Doctoral dissertation). University of Georgia, Athens.

Skinner, B. F. (1958). Teaching machines. *Science, 128*, 969–977. https://doi.org/10.1126/science.128.3330.969

Smart, V. L. (2016). *Technological pedagogical reasoning: The development of teachers' pedagogical reasoning with technology over multiple career stages* (Doctoral thesis, Griffith University, Queensland, Australia). Retrieved from https://www120.secure.griffith.edu.au/rch/items/b658444f-8e00-4c61-9b95-a3b19c62d545/1/

Smart, V., Sim, C., & Finger, G. (2015, March). Are teachers lost in thought with technology? Moving from pedagogical reasoning to technological pedagogical reasoning. Paper presented at the annual meeting of the *Society for Information Technology in Teacher Education*, Las Vegas, NV.

Smeets, E., & van der Horst, J. (2018). *ICT-gebruik in het onderwijs 2018. Stand van zaken in het primair, speciaal en voortgezet onderwijs. [ICT use in Education 2018. State of the art in primary, special and secondary education].* Nijmegen: KBA. Retrieved from:(03/05/2019): https://www.kbanijmegen.nl/ictgebruik_in_het_onderwijs_2018.html.

Smith, R., Kim, S., & McIntyre, L. (2015). Relationships between prospective mathematics teachers' beliefs and TPACK. In T. Bartell, K. Bieda, R. Putnam, K. Bradfield, & H. Dominguez. (Eds.), *Proceedings of the 37th annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education* (pp. 1218-1225). East Lansing, MI: Michigan State University.

Smits, A., Voogt, J. & van Velze, L. (2019). The development of technology integration in a graduate course for practicing teachers. In M. L. Niess, H. Gillow-Wiles C. Angeli (Eds.) Handbook of Research on TPACK in the Digital Age (pp.92-112) Los Angeles: IGI Global. DOI: 10.4018/978-1-5225-7001-1&

So, H. J., & Kim, B. (2009). Learning about problem based learning: Student teachers integrating technology, pedagogy and content knowledge. *Australasian Journal of Educational Technology, 25*(1), 101-116.

Stake, R. E. (1995*). The art of case study research*. Thousand Oaks, CA: Sage.

Stake, R. E. (2006). *Multiple Case Study Analysis*. New York: Guilford.

Starkey, L. (2010). Teachers' pedagogical reasoning and action in the digital age. *Teachers and Teaching, 16*(2), 233-244. http://dx.doi.org/10.1080/13540600903478433

Starkey, L. (2011). Evaluating learning in the 21st century: A digital age learning matrix, *Technology, Pedagogy and Education, 20(*1), 19-39, DOI: 10.1080/1475939X.2011.554021.

Stormbroek, J. (2018). *Instructional Design ADDIE*. [*Instructional design task procedure*] [Teaching material collected through observation.]

Straub, E. T. (2009). Understanding technology adoption: Theory and future directions for informal learning. *Review of Educational Research, 79*(2), 625–649.

Strong, K., & Hutchins, H. (2009). Connectivism: a theory for learning in a world of growing complexity. *Impact: Journal of Applied Research in Workplace E-learning, 1*(1), 53-67. Doi: 10.5043/impact.18

Taylor, R. (1980). *The computer in the school: Tutor, tutee, and tool*. New York: Teacher College Press.

Tellis, W. M. (1997). Application of a Case Study Methodology. *The Qualitative Report, 3*(3), 1-19.

Teo, T. (2009). Modelling technology acceptance in education: A study of pre-service teachers. *Computers & Education, 52*(2), 302–312.

Terpstra, M. (2015). TPACKtivity: An activity – theory lens for examining TPACK development. In C. Angeli & N. Valanides (Eds.), *Technological pedagogical content knowledge. Exploring, developing, and assessing TPCK* (pp.63-88). New York, NY: Springer.

Thagard, P. (2000). *Coherence in thought and action*. Cambridge, MA: MIT Press.

Thompson, A. D. (2008). Breaking news: TPCK becomes TPACK! *Journal of Computing in Teacher Education, 24*(2), 38-64. doi: 10.1080/10402454.2007.10784583

Tondeur, J., Roblin, P. N., van Braak, J., Voogt, J., & Prestridge, S. (2016). Preparing beginning teachers for technology integration in education: Ready for take off? *Technology, Pedagogy and Education, 26*(2), 157-177. doi: 10.1080/1475939X.2016.1193556

Tondeur, J., Scherer, R., Siddiq, F. & Baran, E. (2017). A comprehensive investigation of TPACK within pre-service teachers' ICT profiles: Mind the gap!. *Australasian Journal of Educational Technology, 33*(3), 46- 60.

Tondeur, J., Scherer, R., Siddiq, F., & Baran, E. (2019). Enhancing pre-service teachers' technological pedagogical content knowledge (TPACK): a mixed-method study. *Educational Technology Research and Development,* 1-25. https://doi.org/10.1007/s11423-019-09692-1

Tondeur, J., Valcke, M., & Van Braak, J. (2008). A multidimensional approach to determinants of computer use in primary education: Teacher and school characteristics. *Journal of Computer Assisted Learning, 24*(6), 494–506. https://doi.org/10.1111/j.1365-2729.2008.00285.x.

Tondeur, J., van Braak, J., Sang, G., Voogt, K., Fisser, P., & Ottenbreit-Leftwich, A. (2012). Preparing pre-service teachers to integrate technology in education: A synthesis of qualitative evidence. *Computers & Education, 59* (1), 134-144. doi: 10.1016/j.compedu.2011.10.009

Tondeur, J., van Braak, J., Siddiq, F., & Scherer, R. (2016). Time for a new approach to prepare future teachers for educational technology use: Its meaning and measurement. *Computers & Education, 94*, 134-150.

UniPd (n.d.). *Università degli studi di Padova. Storia*. Retrieved from: https://www.unipd.it/storia

UniPD FISPPA – Department of Philosophy, Sociology, Education and Applied Psychology (n.d.). *Presentazione*. Retrieved from: https://fisppa.unipd.it/dipartimento/presentazione

University of Cyprus. (n.d.). *Vision and mission*. Retrieved from: www.ucy.ac.cy/GoverningBodies/el/vision-and-mission

Valanides, N., & Angeli, C. (2008). Learning and teaching about scientific models with a computer modelling tool. *Computers in Human Behavior, 24*, 220–233.

Valcke, M. (2010). *Onderwijskunde als ontwerpwetenschap. Een inleiding voor ontwikkelaars van instructie en voor toekomstige leerkrachten. [Educational science as a design science. An introduction for developers of instruction and for future teachers*]. Gent: Academia Press.

van Braak, J., van Tondeur, J., & Valcke, M. (2004). Explaining different types of computer use among primary school teachers. *European Journal of Psychology of Education, 19*(4), 407. https://doi.org/10.1007/BF03173218

van den Akker, J. (2003). Curriculum perspectives: An introduction. In J. J. H. van den Akker, W. A. J. M. Kuiper, & U. Hameyer (Eds.), *Curriculum landscapes and trends*, pp.1-10. Dordrecht: Kluwer Academic Publishers.

van den Akker, J., & Thijs, A. (2009). *Leerplan in ontwikkeling. [Curriculum in development*]. Enschede: SLO.

van der Molen, W., van Aalderen-Smeets, J.H., & Asma, S. L. (2010). Teaching science and technology at primary school level: Theoretical and practical considerations for primary school teachers' professional training. In *Proceedings of the IOSTE Symposium on Science and Technology Education*. (pp. -). International Organization for Science and Technology Education, IOSTE.

Van Someren, M. W., Barnard. Y. F., & Sandberg, J.A.C. (1994). *The think aloud method: a practical approach to modelling cognitive processes. (knowledge – based systems)*. London: Academic Press.

Vannatta, R. A., & Fordham, N. (2004). Teacher dispositions as predictors of classroom technology use. *Journal of Research on Technology in Education, 36*(3), 253–271. https://doi.org/10.1080/15391523.2004.10782415.

Venkatesh, V., Thong, J. Y. L., & Xu, X. (2012). Consumer acceptance and use of information technology: Extending the unified theory of acceptance and use of technology. *MIS Quarterly, 36(*1), 157–178.

Verloop, N., Van Driel, J. H., & Meijer, P. C. (2001). Teacher knowledge and the knowledge base of teaching. *International Journal of Educational Research, 35(*5), 441-461. doi: 10.1016/S0883-0355(02)00003-4

Voogt, J, Fisser, P., Tondeur, J., & van Braak, J. (2016). Using theoretical perspectives in developing an understanding of TPACK. In M. C. Herring, M. J. Koehler, & P. Mishra (Eds.), *Handbook of Technological Pedagogical Content Knowledge (TPACK) for Educators, 2nd Edition* (pp. 33-51). London, UK: Routledge.

Voogt, J., & McKenney, S. (2017). TPACK in teacher education: Are we preparing teachers to use technology for early literacy? *Technology, Pedagogy and Education, 26*(1), 69-83. doi: 10.1080/1475939X.2016.1174730

Voogt, J., Fisser, P., Pareja Roblin, N., Tondeur, J., & van Braak, J. (2012). Technological pedagogical content knowledge - a review of the literature. *Journal of Computer-Assisted Learning, 29*(2), 109-121. doi:10.1111/j.1365-2729.2012.00487.x

Voogt, J., Fisser, P., Tondeur, J., & van Braak, J. (2016). Using theoretical perspectives in developing understanding of TPACK. *Handbook of Technological Pedagogical and Content Knowledge for Educators*. Retrieved at: https://www.researchgate.net/publication/295812472_Using_Theoretical_Perspectives_in_Developing_Understanding_of_TPACK.

Voogt, J., Knezek, G., Christensen, R., & Lai, K-W. (2018). Developing an understanding of the impact of digital technologies on teaching and learning in an ever- changing landscape. In Voogt, J., Knezek, G., Christensen, R., & Lai, K-W. (Eds.), *Second handbook of information technology in primary and secondary education* (pp.1-10). Springer International Handbooks of Education. Cham, Switzerland: Springer. doi.org/10.1007/978-3-319-53803-7_113-1

Voogt, J., van Braak, J., Heitink, M., Verplanken, L., Fisser, P., & Walraven, A. (2013). *Didactische ICT-bekwaamheid van docenten*. Zoetermeer: Kennisnet.

Vrasidas, C. (2014). The rhetoric of reform and teachers' use of ICT. *British Journal for Educational Technology, 46*(2). DOI: 10.1111/bjet.12149.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.

Wang, L., Ertmer, P. A., & Newby, T. J. (2004). Increasing preservice teachers' self-efficacy beliefs for technology integration. *Journal of Research on Technology in Education, 36*(3), 231–250.

Wang, Q. (2008). A generic model for guiding the integration of ICT into teaching and learning. *Innovations in Education and Teaching International, 45*(3), 411-419. doi: 10.1080/14703290802377307

Wang, Q. (2009). Guiding teachers in the process of ICT integration. Analysis of three conceptual models. *Educational Technology, 49*(5), 23-27.

Wang, Z., Chen, L., & Anderson, T. (2014). A Framework for Interaction and Cognitive Engagement in Connectivist Learning Contexts. *International Review of Research in Open and Distributed Learning, 15(2)*. Retrieved at: http://www.irrodl.org/index.php/irrodl/article/view/1709/2886

Wasicsko, M. M. (2007). The perceptual approach to teacher dispositions. In M. E. Diez, & J. Raths (Eds.), *Dispositions in teacher education* (p. 53-91). Charlotte, NC: Information Age Publishing Company.

Webb, M. (2010). Models for exploring and characterising pedagogy with information technology. In A. McDougall, J. Murnane, A. Jones & N. Reynolds (Eds.), *Researching IT in Education: Theory, Practice and Future Directions* (pp. 91-111). Abingdon, Oxon: Routledge.

Webb, M. E. (2002). Pedagogical reasoning: Issues and solutions for the teaching and learning of ICT in secondary schools. *Education and Information Technologies, 7*(3), 237–255.

Webb, M., & Cox, M. (2004). A review of pedagogy related to information and communications technology. *Technology, Pedagogy, and Education, 13*(3), 235-286. doi:10.1080/14759390400200183.

Wikipedia (n.d./b). *Italy on the globe*. Retrieved from: https://ia.wikipedia.org/wiki/File:Italy_on_the_globe_(Europe_centered).svg

Wikipedia (n.d./c). *The Netherlands on the globe*. Retrieved from: https://ia.wikipedia.org/wiki/File:Netherlands_on_the_globe_(Europe_centered).svg

Wikipedia. (n.d./a). *Cyprus on the globe*. Retrieved from: https://commons.wikimedia.org/wiki/File:Northern_Cyprus_on_the_globe_(Europe_centered).svg

Williams, M. K., Foulger, T., & Wetzel, K. (2010). Aspiring to reach 21st century ideals: Teacher educators' experiences in developing their TPACK. In D. Gibson & B. Dodge (Eds.), *Proceedings of Society for Information Technology & Teacher Education International Conference 2010* (pp. 3960-3967). Chesapeake, VA: Association for the Advancement of Computing in Education (AACE).

Wilson, S., Shulman, L., & Richert, A. (Eds.). (1987). *150 Different ways of knowing: Representations of knowledge in teaching.* Sussex: Holt, Rinehart, & Wiston.

Windesheim (n.d./a). *Windesheim University of Applied Science. Mission, Ambition and Strategy*. Retrieved from: https://www.windesheim.com/about-windesheim/mission-and-vision

Windesheim (n.d./b). *Windesheim education*. Retrieved from: https://www.windesheim.nl/studeren/zoeken?filters=Onderwijs.

Yagci, M. (2016). Effects of pre-service information technologies (IT) teachers' thinking styles on their use of information and communication technology (ICT). *Educational Research and Reviews, 11*(2), 48–58.

Yeh, Y. F., Hsu, Y. –S., Wu, H.-K., Hwang, F.-K., & Lin, T.-C. (2014). Developing and validating technological pedagogical content knowledge – Practical (TPACK-Practical) through the Delphi survey technique. *British Journal of Educational Technology, 45*(4), 707-722. doi: 10.1111/bjet.12078

Yeh, Y., Hsu, Y., Wu, H., & Chien, S. (2017). Exploring the structure of TPACK with video-embedded and discipline-focused assessments. *Computers & Education, 104*, 49–64.

Yilmaz-Ozden, S., Mouza, C. & Harlow Shinas, V. (2016). Teaching knowledge with curriculum-based technology: Development of a survey instrument for pre-service teachers. *Journal of Technology and Teacher Education, 24*(4), 471-499

Yin, R. K. (1981). The Case Study Crisis: Some Answers. *Administrative Science Quarterly, 26*(1), 58-65.

Yin, R. K. (1994). *Case study research: Design and Methods. 2nd edition. Applied Social Research Methods Series, volume 5*. Thousand Oaks, CA: Sage.

Yin, R. K. (2003). *Case study research: Design and methods (3rd ed.*). Thousand Oaks, CA: Sage.

Yin, R. L. (1993). *Applications of case study research*. Newbury Park, CA: Sage.

Yin, R. L. (2008). *Case study Research and Applications: Design and Methods*. *6th edition*. Los Angeles: Sage.

Yusop, F. D. (2015). A dataset of factors that influence preservice teachers' intentions to use web 2.0 technologies in future teaching practices. *British Journal of Educational Technology, 46*(5), 1075–1080.

Zee, M., & Koomen, H. M. Y. (2016). Teacher self-efficacy and its effects on classroom processes, student academic adjustment, and teacher well-being: A synthesis of 40 years of research. *Review of Educational Research, 86*(4), 981–1015.

LEGISLATIVE REFERENCES

UNESCO International Bureau of Education (2012). *World Data on Education. VII Ed. 2010/11, Updated version, October 2012*. Retrieved from http://www.ibe.unesco.org/en/document/world-data-education-seventh-edition-2010-11

OCW (n.d.). *Ministry of Education, Culture and Science*. Retrieved from: https://www.government.nl/ministries/ministry-of-education-culture-and-science

OECD (2013). *Teaching and Learning International Survey (Talis) 2013*. Retrieved from: http://www.oecd.org/education/school/Nederland-Talis-2013-rapport_nl.pdf.

OECD (2014). *Education Policy Outlook – Netherlands*. Retrieved from: http://www.oecd.org/education/EDUCATION%20POLICY%20OUTLOOK_NETHERLANDS_EN%20.pdf

OECD (2018). *Education at a Glance 2018: OECD Indicators*. OECD Publishing: Paris. Retrieved from: https://doi.org/10.1787/eag-2018-en

Nuffic (2018). *Education system. The Netherlands. The Dutch education system described. Fifth edition*. Retrieved from: https://www.nuffic.nl/en/subjects/education-in-the-netherlands/

Netherlands (1998a). Expertise Centres Act.

Netherlands (1998b). Secondary Education Act.

Netherlands (2006). Education professions act.

Netherlands (2010a). Opportunities for Development through Quality and Education Act (OKE- 2010).

Netherlands (2010b). Childcare and Quality Standards for Playgrounds Act (2010)

Netherlands (2010c). Primary Education Act.

Netherlands (2010d). Benchmarks Act.

Netherlands (2010e). Good Education and Good Governance Act.

MIUR (1993). Law 537/1993.

MIUR (2015). Law 107/2015.

MOEC (2017a). *Annual Report 2017*. Retrieved from: http://www.moec.gov.cy/en/annual_reports/annual_report_2017_en.pdf

MOEC (2017b). *Στοχοι Σχολικης Χρονιας Υπουργειου Παιδειας Και Πολιτισμου. Σχολική Χρονιά 2017-2018 (School schedule objectives of the ministry of education and culture. School year 2017-2018*). Retrieved from: http://www.moec.gov.cy/stochoi/index.html

MOEC (n.d./a). *Analytical programmes – Indicators of success – capability*. Retrieved from: http://www.moec.gov.cy/analytika_programmata/programmata_spoudon.html

MOEC Department of general secondary education (n.d.) *Innovations – Reforms – Structural Changes*. Retrieved from: http://www.moec.gov.cy/dme/en/innovations_reforms_lyk.html

MOEC Department of Primary Education. (n.d./a) *Pre-Primary education*. Retrieved from: http://www.moec.gov.cy/dde/en/preprimary_introduction.html

MOEC Department of Primary Education. (n.d./b) *Primary education*. Retrieved from: http://www.moec.gov.cy/dde/en/primary_introduction.html

MOEC. (n.d./b). *Special Education*. Retrieved from: http://www.moec.gov.cy/eidiki_ekpaidefsi/en/gen_info_special_education.html

Italian Constitution (1947). Retrieved from: https://www.senato.it/documenti/repository/istituzione/costituzione.pdf

Italy (1971). Law n. 1044/1971

Italy (1977). Law 517/1977.

Italy (1992). Law 104/1992.

Italy (2006). Law n.27, 3/02/2006.

Italy (2007). Ministerial Decree 31/07/2007

Italy (2008a). DPCM 25/01/2008

Italy (2008b). Law n. 53, 28/03/2008

Italy (2008c). Law n169, 30/10/2008

Italy (2009). Decree of the President of the Republic 81, 89/2009

Italy (2010a). Law n.170, 8/10/2010

Italy (2010b). Law n.240, 30/12/2010. *Norme in materia di organizzazione delle università, di personale accademico e reclutamento, nonché delega al Governo per incentivare la qualità e l'efficienza del sistema universitario*.

Italy (2010c). Decree of the President of the Republic 87,88/2010

Italy (2011). Inter-ministerial Decree 7/09/2011

Italy (2012). Ministerial Decree n. 254, 16/11/2012. Retrieved from: http://www.indicazioninazionali.it/wp-content/uploads/2018/08/decreto-ministeriale-254-del-16-novembre-2012-indicazioni-nazionali-curricolo-scuola-infanzia-e-primo-ciclo.pdf

Italy (2013). Law n128, 8/11/2013

Italy (2015). DM 435/2015.

Italy (2015). *PNSD - Piano Nazionale Scuola Digitale*. Retrieved from: http://www.istruzione.it/scuola_digitale/index.shtml

Italy (2017). DLgs 65/2017.

European Agency for Special Needs and Inclusive Education (n.d.). *ICT for inclusion. Cyprus Report*. Retrieved from: https://www.european-agency.org/sites/default/files/Cyprus.pdf

European Commission (2010). *Europe 2020 strategy*. Retrieved from: https://ec.europa.eu/info/business-economy-euro/economic-and-fiscal-policy-coordination/eu-economic-governance-monitoring-prevention-correction/european-semester/framework/europe-2020-strategy_en

European Commission/EACEA/Eurydice (2018). *Teaching Careers in Europe: Access, Progression and Support*. Eurydice Report. Luxembourg: Publications office of the European Union.

European Parliament (2006). *European Recommendation of the European Parliament and of the Council of 18 December 2006 on key competences for lifelong learning*. Retrieved from: https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:394:0010:0018:en:PDF

Eurostat (2017). *Being young in Europe today- digital world*. Retrieved from (15/05/2019): https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Being_young_in_Europe_today_-_digital_world#A_digital_age_divide.

Eurostat (2019). *Digital economy and society statistics – households and individuals*. Retrieved from (16/08/2019):https://ec.europa.eu/eurostat/statistics-explained/index.php/Digital_economy_and_society_statistics_-_households_and_individuals#Internet_usage

Eurydice (2017). *Cyprus. Organization and Governance*. Retrieved from: https://eacea.ec.europa.eu/national-policies/eurydice/content/organisation-and-governance-15_hr?2nd-language=nl

Eurydice (2018a). *Cyprus. Key features of the Education system*. Retrieved from: https://eacea.ec.europa.eu/national-policies/eurydice/content/organisation-and-governance-15_hr?2nd-language=nl

Eurydice (2018b). *National Education Policies. Italy*. Retrieved from: https://eacea.ec.europa.eu/national-policies/eurydice/content/italy_en

Eurydice (2018c). *National Education Policies. The Netherlands*. Retrieved from: https://eacea.ec.europa.eu/national-policies/eurydice/content/netherlands_en

Eurydice (2019). *National Education Systems. The Netherlands.* Retrieved from (02/05/2019): (https://eacea.ec.europa.eu/national-policies/eurydice.

Cyprus (1971). Laws on Private Schools and Institutes (Law 5/1971).

Cyprus (1989). University of Cyprus Law (Ο περί του Πανεπιστημίου Κύπρου Νόμος του 1989, Ν.144/1989).

Cyprus (1996a). Law 68 (I) /1996 retrieved from www.kysats.ac.cy/index.php/el/kysats/idrysi

Cyprus (1996b). Tertiary Education Schools Law (Ο περί Σχολών Τριτοβάθμιας Εκπαίδευσης Νόμος του 1996, N. 67(I)/1996).

Cyprus (2004a). Decision of the Council of Ministers n. 59.824 (14/04/2004).

Cyprus (2004b). Primary and Secondary Education (Obligatory Education and Free Education - Amendment) Law of 2004 (Νόμος του 2004 N. 220(I)/2004).

Cyprus (2008a). Elementary Education Law Regulation (ΚΔΠ 225/2008.)

Cyprus (2008b). Law on Private Schools and Institutes (77(I)/2008).

Cyprus (2009). Elementary Education Law Regulation (ΚΔΠ 276/2009).

Cyprus (2011). Children Regulations 2011 (Περί Παιδίων -Παιδοκομικοί Σταθμοί – Διάταγμα του 2011, Κ.Δ.Π. 262/2011).

Cyprus (2014). Children Law, Chap. 352 (Περί Παιδίων Νόμος, Κεφ. 352, 181(I)/2014).

Cyprus (2017). Regulations on the Operation of Public schools of 2017 (Κ.Δ.Π. 60/2017).

Cyprus Pedagogical Institute (n.d.). *Training programs*. Retrieved from: https://www.e-epimorfosi.ac.cy/index.php.

APPENDIX

Note: when relevant, documents will be presented in the original language and then in their English translation.

APPENDIX 1. CONTEXTS

1.1A. CYPRUS CASE STUDY: COURSE SUMMARY

ΕΚΠΑΙΔΕΥΤΙΚΗ ΤΕΧΝΟΛΟΓΙΑ
ΔΗΜΟΤΙΚΗ ΕΚΠΑΙΔΕΥΣΗ
ΧΕΙΜΕΡΙΝΟ ΕΞΑΜΗΝΟ
2017-2018

Πανεπιστήμιο Κύπρου
Τμήμα Επιστημών της Αγωγής

ΔΙΑΓΡΑΜΜΑ ΜΑΘΗΜΑΤΟΣ

Κωδικός Μαθήματος:	ΕΠΑ 138
Τίτλος Μαθήματος:	Εκπαιδευτική Τεχνολογία
Ηλεκτρονικό Σύστημα Διαχείρισης:	Blackboard 6
Προαπαιτούμενα:	ΕΠΛ 001/002 (Πληροφορική)
Καθηγήτρια:	[redacted]
Ώρες Γραφείου:	Τετάρτη, 10:00-12:00
Τηλέφωνο:	[redacted] (κινητό)
Ηλεκτρονικό Ταχυδρομείο:	[redacted]
Ταχυδρομική Θυρίδα:	Τμήμα Επιστημών της Αγωγής, 4ος όροφος, #411
Διδάσκουσα Εργαστηρίων:	Άντρη Χριστοδούλου

Περιγραφή και φιλοσοφία του μαθήματος

Το μάθημα της Εκπαιδευτικής Τεχνολογίας στο Τμήμα ΕΠΑ του Πανεπιστημίου Κύπρου αποβλέπει όχι μόνο να εφοδιάσει τους μελλοντικούς εκπαιδευτικούς με ικανότητες χρήσης τεχνολογικών εργαλείων και λογισμικών, αλλά κυρίως, να τους καταστήσει ικανούς για το σχεδιασμό και τη δημιουργία αλληλεπιδραστικών μαθησιακών περιβαλλόντων με την ενσωμάτωση των ψηφιακών τεχνολογιών. Επομένως, το μάθημα δεν επιδιώκει απλά να αποκτήσουν οι φοιτητές/τριες δεξιότητες χρήσης της τεχνολογίας, αλλά να συναναπτύξουν τις ικανότητες αυτές σε παιδαγωγικές εφαρμογές που τους υποβοηθούν να διερευνούν και να διευρύνουν την παιδαγωγική γνώση του περιεχομένου των μαθημάτων που θα διδάξουν. Αναλυτικότερα, το μάθημα βασίζεται στη φιλοσοφία ότι η τεχνολογία δεν είναι αξιολογικά ουδέτερη, ούτε και αυτοσκοπός, αλλά δυναμικό και ισχυρότατο μέσο για την κατάκτηση μαθησιακών στόχων. Επομένως, *η τεχνολογία από μόνη της*, ανεξάρτητα από την ποιότητα και την εμβέλειά της, έχει περιορισμένες δυνατότητες για υποστήριξη της μάθησης. Η τοποθέτηση αυτή απορρίπτει τη θεώρηση της τεχνολογίας ως ένα είδος Δούρειου Ίππου που από μόνη της θα μπορούσε να διαφοροποιήσει τη διαδικασία διδασκαλίας και μάθησης. Επομένως, αν η τεχνολογία θεωρηθεί ως απλό προσάρτημα του μαθησιακού περιβάλλοντος, που χρησιμοποιείται χάριν της απλής τεχνολογικής αναβάθμισής του, τότε οι δυνατότητές της να ενεργοποιήσει τους μηχανισμούς μάθησης ελαχιστοποιούνται. Μόνο με τη θεώρηση της τεχνολογίας ως σημαντικού μαθησιακού και νοητικού εργαλείου που έχει, σε *επιλεγμένες διδακτικές περιπτώσεις,* δυνατότητες προστιθέμενης μαθησιακής αξίας, δικαιολογούνται τόσο οι προσπάθειες όσο και οι δαπάνες που σχετίζονται με την ενσωμάτωση των νέων τεχνολογιών στη μαθησιακή διαδικασία. Τα διάφορα τεχνολογικά γνωστικά ή νοητικά εργαλεία εμπλέκουν τα μανθάνοντα άτομα σε νοητικές διαδικασίες για την ανάλυση και την κριτική εξέταση του περιεχομένου της διδασκαλίας ή του αντικειμένου της μάθησης και διευκολύνουν την οργάνωση και αναπαράσταση των γνωστικών τους δομών. Η μάθηση με την αξιοποίηση νοητικών εργαλείων εξαρτάται απόλυτα από τη γνωστική εμπλοκή των ατόμων σε μαθησιακές διαδικασίες που υποστηρίζονται από αυτά, με αποτέλεσμα να δημιουργούνται οι προϋποθέσεις ποιοτικής αναβάθμισης της απόδοσης του *κοινωνικο-τεχνικού συστήματος* που συναποτελείται από τους μανθάνοντες και την τεχνολογία, αλλά υπερβαίνει το απλό άθροισμά τους. Ο κατάλογος των νοητικών εργαλείων στα οποία γίνεται αναφορά περιλαμβάνει ανάμεσα σε άλλα τα εργαλεία χαρτογράφησης εννοιών, τους μικρόκοσμους, τις προσομοιώσεις, τα εργαλεία μοντελοποίησης, τα εργαλεία ψηφιακής αφήγησης, την εκπαιδευτική ρομποτική, το Διαδίκτυο και τα πολυμέσα και υπερμέσα. Ως εκ τούτου, το μάθημα επιδιώκει την ανάπτυξη της Τεχνολογικής Παιδαγωγικής Γνώσης Περιεχομένου (ΤΠΓΠ) των μελλοντικών εκπαιδευτικών. Η ΤΠΓΠ, ως μετασχηματιστικό σώμα γνώσης, ορίζεται ως η απαραίτητη γνώση για κατάλληλο διδακτικό μετασχηματισμό του περιεχομένου, αλλά και της παιδαγωγικής γνώσης, για τη διδασκαλία σε συγκεκριμένους μαθητές ή φοιτητές και σε συγκεκριμένο εκπαιδευτικό πλαίσιο, με τρόπο ώστε να αναδεικνύεται η προστιθέμενη αξία των δυνατοτήτων των τεχνολογικών εργαλείων (Angeli & Valanides, 2009).

Σκοποί του μαθήματος

1. Η οικοδόμηση και η εφαρμογή γνώσεων διδακτικού σχεδιασμού με τη χρήση της ψηφιακής τεχνολογίας.
2. Η ενσωμάτωση μαθησιακών δραστηριοτήτων ενισχυμένων με την τεχνολογία στο αναλυτικό πρόγραμμα της δημοτικής εκπαίδευσης.
3. Η κατανόηση των σχέσεων μεταξύ των θεωριών μάθησης, διδακτικών προσεγγίσεων και εκπαιδευτικής τεχνολογίας.
4. Η αξιολόγηση ανοικτού και κλειστού τύπου λογισμικών προγραμμάτων.
5. Η ανάπτυξη μαθησιακών δραστηριοτήτων με τα λογισμικά Lego WeDo, Kidspiration, WeVideo και Microworlds Jr.

Τι πρέπει να αγοράσετε

1. Το βιβλίο των αναγνωσμάτων από το Majorbox.
2. Ένα σετ CDς (3) με τα λογισμικά Lego WeDo, Kidspiration και Microworlds Jr. από το Majorbox.
3. Ένα memory stick.
4. <u>Όταν έχετε εργαστήριο να έχετε πάντα μαζί σας το memory stick.</u>

Τι πρέπει να κατεβάσετε από το διαδίκτυο:

1. Τα κείμενα των αναλυτικών προγραμμάτων της δημοτικής εκπαίδευσης από την ιστοσελίδα του Υπουργείου Παιδείας και Πολιτισμού: http://www.moec.gov.cy/analytika_programmata/programmata_spoudon.html

Κανονισμοί για το Μάθημα

1. Η παρακολούθηση των μαθημάτων είναι υποχρεωτική. Λόγω της φύσης του μαθήματος (η συνανάπτυξη δεξιοτήτων χρήσης της τεχνολογίας με εκπαιδευτικό σχεδιασμό και εφαρμογή αρχών μάθησης) είναι αναγκαίο οι φοιτητές/τριες να παρακολουθούν όλες τις διαλέξεις και τα εργαστήρια.
2. Σε περίπτωση που ένας φοιτητής/τρια χρειαστεί να παρακολουθήσει ένα εργαστήριο στο οποίο δεν έχει κάνει εγγραφή θα του/της επιτραπεί εάν υπάρχει ελεύθερος ΗΥ.
3. Δεν επιτρέπεται η αδικαιολόγητη μετακίνηση από το ένα εργαστήριο στο άλλο.
4. Η καθυστέρηση ολοκλήρωσης των εργασιών συνεπάγεται μείωση της αντίστοιχης βαθμολογίας για κάθε εργασία κατά 5%.

5. Ο/Η κάθε φοιτητής/τρια πρέπει να έχει πρόσβαση σε ηλεκτρονικό ταχυδρομείο.
6. Απαιτείται η έγκαιρη παρουσία των φοιτητών/τριών στη διάλεξη και στο εργαστήριο.
7. Δεν επιτρέπεται το φαγητό-ποτό στο εργαστήριο και διάλεξη.
8. Είναι απαραίτητο να κλείνουν τα κινητά τηλέφωνα κατά τη διάρκεια των μαθημάτων.
9. Εργασίες που έχουν υποβληθεί για βαθμολόγηση και που είναι αντιγραφή εργασιών άλλων φοιτητών/τριών θα επισύρουν τις συνέπειες των κανονισμών του Πανεπιστημίου.
10. Η αντιγραφή κατά τη διάρκεια διαγωνίσματος ή τελικής εξέτασης θα έχει τις συνέπειες που προβλέπουν οι κανονισμοί του Πανεπιστημίου.

Αξιολόγηση

1.	Εργασία (ατομική ή ομαδική μέχρι 3 άτομα) αξιοποίησης του Kidspiration	20%
2.	Εργασία αξιοποίησης του WeVideo (ψηφιακή αφήγηση) (ατομική)	20%
3.	Συμμετοχή στο e-TPCK (τρεις δίωρες συναντήσεις)	20%
4.	Τελική Εξέταση	40%
	ΣΥΝΟΛΟ	100%

*****Επιτυχία στο μάθημα προϋποθέτει επιτυχία σε όλες τις εργαστηριακές ασκήσεις και στην τελική εξέταση.***

Βιβλιογραφία

I. Βιβλίο Κειμένων (υποχρεωτικό βιβλίο κειμένων το οποίο πρέπει να αγοραστεί από το "Majorbox")

1. Angeli, C., & Valanides, N. (2009). Epistemological and Methodological Issues for the Conceptualization, Development, and Assessment of ICT-TPCK: Advances in Technological Pedagogical Content Knowledge (TPCK). *Computers & Education*, *52*, 154-168. (σε ελληνική μετάφραση)
2. Angeli, C., & Valanides, N. (in press). Knowledge base for ICT in education. In J. Voogt & G. Knezek (Eds.), The International Handbook of Information Technology in Primary and Secondary Education (2nd edition). NY: Springer. (σε ελληνική μετάφραση)
3. Angeli, C., & Valanides, N. (2013). Technology Mapping: An Approach for the Development of Technological Pedagogical Content Knowledge. *Journal of Educational Computing Research, 48*(2), 199-221. (σε ελληνική μετάφραση)
4. Βοσνιάδου, Σ. (2001). *Πώς Μαθαίνουν οι Μαθητές*. Αθήνα: Διεθνής Ακαδημία της εκπαίδευσης.
5. Αγγελίδης Ν., Ευθυμιόπουλος Α., Λιούτα Χ., Μασούρου Β. (2009). *Θεωρίες μάθησης, διδακτικη πράξη & σύγχρονες μορφές εκπαίδευσης*. Ηλεκτρονικό αντίγραφο του βιβλίου.
6. Κόμης, Β. (1998). *Οι νέες τεχνολογίες στη διδακτική και μαθησιακή διαδικασία. Μια Τυπολογία των Παιδαγωγικών Δραστηριοτήτων και Αντιλήψεων και των ψυχολογικών Προσεγγίσεων*, 23-34.
7. Φεσάκης, Γ. (2012). Τεχνολογίες Πληροφορικής και Επικοινωνιών στην προσχολική εκπαίδευση, διαστάσεις και προοπτικές. *Πρακτικά του 4ου Πανελλήνιου Συνεδρίου στη Διδακτική της Πληροφορικής*.
8. Αγγελίδης Ν., Ευθυμιόπουλος Α., Λιούτα Χ., Μασούρου Β. (2009). *Θεωρίες μάθησης, διδακτικη πράξη & σύγχρονες μορφές εκπαίδευσης*. Ηλεκτρονικό αντίγραφο του βιβλίου.
9. Dimitriadis, S., & Δημητριάδης, Σ. (2015). *Θεωρίες μάθησης και εκπαιδευτικό λογισμικό*. Ηλεκτρονικό αντίγραφο του βιβλίου.

II. **Σημειώσεις από την καθηγήτρια**

III. **Περιοδικά (Αναζητήστε τα στο Διαδίκτυο)**

1. British Journal of Educational Technology
2. Journal of Computing on Technology in Education
3. Learning and Leading with Technology
4. Contemporary Issues in Technology Education (CITE)
5. Computers and Education
6. Computers in Human Behavior

IV. **Πηγές στο Διαδίκτυο**

1. WeVideo software: https://www.wevideo.com/
2. Inspiration software. Διαθέσιμο στο: http://www.inspiration.com

3. Kidspiration software. Διαθέσιμο στο: http://www.kidspiration.com
4. Lego WeDo robotics kit: https://education.lego.com/en-us/products/lego-education-wedo-construction-set/9580
5. International Society for Technology in Education: https://www.iste.org/

Πρόγραμμα Διαλέξεων και Εργαστηρίων

Εβδομάδα	Διάλεξη	Εργαστήριο
1	-Γνωριμία με τους φοιτητές /τριες -Πληροφορίες για το μάθημα. -Διάγραμμα μαθήματος.	Πληροφορίες για το εργαστήριο και την εγκατάσταση λογισμικών. Blackboard 6.
2	-Η συμβολή της ψηφιακής τεχνολογίας στη διδασκαλία και μάθηση. -Είδη λογισμικών προγραμμάτων. -Εκπαιδευτικός σχεδιασμός.	-Εργαλεία χαρτογράφησης. -Kidspiration.
3	-Μεθοδολογία της διδασκαλίας ενισχυμένης με την τεχνολογία. -Εκπαιδευτικός σχεδιασμός με την τεχνολογία. -Τεχνολογική παιδαγωγική γνώση περιεχομένου (ΤΠΓΠ).	-Kidspiration. -Σενάρια εκπαιδευτικού σχεδιασμού με το Kidspiration.
4	-Μεθοδολογία της διδασκαλίας ενισχυμένης με την τεχνολογία. -Θεωρίες μάθησης και διδακτικές προσεγγίσεις. -Ευθυγράμμιση θεωριών μάθησης, με διδακτικές προσεγγίσεις και τεχνολογία. -ΤΠΓΠ. -Λογισμικά κλειστού τύπου.	-Kidspiration. -Σενάρια εκπαιδευτικού σχεδιασμού με το Kidspiration.
5	-Ψηφιακή αφήγηση.	-WeVideo. -Δημιουργία ψηφιακών ιστοριών.
6	Εκπαιδευτική ρομποτική. -Bee-Bot -Blue-Bot -Probot	-WeVideo. -Δημιουργία ψηφιακών ιστοριών.
7	Εκπαιδευτική ρομποτική. -Bee-Bot -Blue-Bot -Probot	-Μαθησιακές δραστηριότητες με το WeVideo.
8	-Games and quizzes.	-Εκπαιδευτική ρομποτική με το Lego WeDo.
9	-Games and quizzes.	-Εκπαιδευτική ρομποτική με το Lego WeDo.
10	-Η ενσωμάτωση των μικρόκοσμων, της μοντελοποίησης και των προσομοιώσεων στη μαθησιακή διαδικασία.	-Μαθησιακές δραστηριότητες με το Microworlds Jr.
11	-Η ενσωμάτωση των μικρόκοσμων, της μοντελοποίησης και των προσομοιώσεων στη μαθησιακή διαδικασία.	-Μαθησιακές δραστηριότητες με το Microworlds Jr.
12	-Η ενσωμάτωση των μικρόκοσμων, της μοντελοποίησης και των προσομοιώσεων στη μαθησιακή διαδικασία.	-Μαθησιακές δραστηριότητες με το Microworlds Jr.
13	-Ανασκόπηση.	-Ανασκόπηση.

EDUCATIONAL TECHNOLOGY
Primary Education
WINTER SEMESTER
2017 -2018

Πανεπιστήμιο Κύπρου
Τμήμα Επιστημών της Αγωγής

COURSE DIAGRAM

Lesson Code:	E 138
Course title:	Educational Technology
Electronic Management System:	Blackboard 6
Prerequisites:	EP 001/002 (Information Technology)
Professor :	[redacted]
Office hours:	Wednesday , 1 0 : 00-1 2 : 0 0
Phone:	[redacted] (mobile)
Email:	[redacted]
PO Box:	Department of Educational Sciences, [redacted]
Laboratory Instructor:	Andri Christodoulou

Description and philosophy of the course

The course in Educational Technology at the Department of Computer Science at the University of Cyprus aims not only to provide future teachers with skills in the use of technological tools and software but also to enable them to design and create interactive learning environments by integrating digital technologies. Therefore, the lesson does not simply seek to acquire student skills in using technology but to develop these skills in pedagogical applications that help them explore and broaden the pedagogical knowledge of the content of the lessons they will teach. In more detail, the lesson is based on the philosophy that technology is neither evaluative nor neutral, but a powerful means for achieving learning goals. Therefore, *technology alone*, regardless of its quality and scope, has limited capabilities to support learning. This attitude rejects technology considerations as a kind of Trojan Horse that alone could diversify the teaching and learning process. Therefore, if technology is seen as a mere appendage to the learning environment used for its simple technological upgrading, then its ability to activate learning mechanisms is minimized. Only by considering technology as an important learning and intellectual tool that has added learning value in *selected teaching situations* justifies both the efforts and the costs associated with the integration of new technologies into the learning process. The various cognitive or cognitive tools involve stuttering individuals in cognitive processes to analyze and critically examine the content of the teaching or object of learning, and facilitate the organization and representation of their cognitive structures. Learning with the use of cognitive tools is fully dependent on the cognitive involvement of individuals in the learning processes supported by them, thus creating the conditions for qualitative upgrading of the performance of the *socio-technical system* made up of the learners and the technology but goes beyond simple summation. The list of cognitive tools to be cited includes, among other things, concept mapping, microcosms, simulations, modeling tools, digital narrative tools, educational robotics, the Internet and multimedia and hypermedia. Therefore, the course seeks to develop the

Future Teachers' Knowledge-Based Knowledge (TKB). TPCK, as transformative body knowledge, defined as necessary knowledge for suitable teaching transformation of content, and pedagogy knowledge, for the teaching to specific students or in a specific educational context, in order to highlight the added value of the potential of technological tools (Angeli & Valanides, 2009).

Aims of the lesson

1. The building n century implementing instructional design knowledge using of digital technology.
2. The integration of technology- enhanced learning activities into the curriculum of pre-primary education .
3. Understanding the relationship between learning th theories, teaching approaches and educational technology.
4. The evaluation of open and closed software programs.
5. The development of learning activities with Lego software WeDo, Kidspiration, WeVideo and Microworlds Jr.

What to buy

1. The book of readings from Majorbox.
2. One set CD (3) with the software Lego WeDo, Kidspiration and Microworlds Jr. from the Majorbox.
3. One memory stick.
4. When you go to the a lab you must always have the memory stick with you.

What to download from the internet:

1. The texts of pre- primary curricula from the Ministry of Education and Culture website: http://www.moec.gov.cy/analytika_programmata/programmata_spoudon.html

Lesson Regulations

1. Course attendance is mandatory. Due to the nature of the course (co-development of technology use with educational design and application of learning principles) it is necessary for students to attend all lectures and workshops .
2. In case a student needs to attend a workshop he has not registered, he / she will be allowed if there is a free PC.
3. Unnecessary movement from one laboratory to another is not allowed.
4. The delay in completing the work entails a 5% reduction in the corresponding score for each job.
5. Each student must have access to e-mail.
6. Timely attendance of students is required at the lecture and in the workshop.
7. Not allowed to eat and drink in the laboratory and lecture .
8. It is necessary to close the mobile phones during the course.
9. Jobs submitted for grading and copying work of other students will result in the consequences of the University's regulations.
10. Copying during a competition or final examination will have the implications provided by the University's regulations.

Evaluation

1.	Work (individual or fellow until 3 people) exploiting Kidspiration	20 %
2.	Work WeVideo exploitation (digital storytelling) (individual)	20 %
3.	Participation in e - TPCK (three-hour meetings)	20 %
4.	Final Examination	40 %
	total	100%

***** Success in the course presupposes success in all laboratory exercises and final examination.***

Bibliography

I Book of Texts (mandatory text book to be purchased from M ajorbox)

1. Angeli, C., & Valanides, N. (2009). epistemological and methodological issues for the conceptualization, development and assessment of ICT-TPCK: advances in technological pedagogical content knowledge (TPCK) . C*omputers & education*, *52*, 154-168. (in Greek translation)
2. Angeli, c., & Valanides, n. (in press). knowledge base for ICT in education. in J. Voogt & G. Knezek (eds*.), The international handbook of information technology in primary and secondary education (2nd edition).* NY: Springer. (in Greek translation)
3. Angeli, C., & Valanides, N. (2013). Technology mapping: an approach for the development *of technological pedagogical content knowledge. Journal of educational computing research, 48 (2), 199-221. (in Greek translation)*
4. Bosniadou, S. (2001). *How students learn. Athens: International academy of education.*
5. *Papageli, A., & Athanasopoulou, M. (2012). The effectiveness of traditional narration and digital imaging in preschool age. Proceedings of the Hellenic institute of applied education and training (hel.iepe.k.), 6th Panhellenic Conference, 5-7 october 2012.*
6. Nikiforidou, Z., & Pagge, T. (2016). digital game in preschool age. I*nternational conference on open & distance learning*, *6* (1a).

10. Styliaras, G., Dimou, V., Στυλιαράς, Γ., & Δήμου, Β. (2015). *Σύγχρονες θεωρίες μάθησης και συνεισφορά στον σχεδιασμό εκπαιδευτικών υπολογιστικών περιβαλλόντων.*

11. Dimitriadis, S., & Δημητριάδης, Σ. (2015). *Θεωρίες μάθησης και εκπαιδευτικό λογισμικό*. Ηλεκτρονικό αντίγραφο του βιβλίου.

II.Notes by the Professor

III.Magazines (search the internet)

7. British Journal of Educational Technology
8. Journal of Computing on Technology in Education
9. Learning and Leading with Technology
10. Contemporary Issues in Technology Education (CITE)
11. Computers and Education
12. Computers in Human Behavior

IV. Internet resources

1. WeVideo software: https://www.wevideo.com/
2. Inspiration software. Διαθέσιμο στο: http://www.inspiration.com
3. Kidspiration software. Διαθέσιμο στο: http://www.kidspiration.com
4. Lego WeDo robotics kit: https://education.lego.com/en-us/products/lego-education-wedo-construction-set/9580
5. International Society for Technology in Education: https://www.iste.org/

Program of Lectures and Workshops

Week	Lecture	Laboratory
1	- Getting acquainted with the students - Information about the lesson. - Course diagram .	Laboratory information and software installation . Blackboard 6 .
2	- The contribution of digital technology to teaching and learning. - Types of software programs . - Educational design .	- Mapping tools . - Kidspiration .
3	- Methodology of technology-enhanced teaching . - Educational design with technology. -Technological pedagogical knowledge of content (TPCK) .	- Kidspiration . - Scripts of educational design with Kidspiration .
4	- Methodology of technology-enhanced teaching . - Learning theories and teaching approaches . - Aligning learning theories with teaching approaches and technology. - TPCK. -Closed-type software .	- Kidspiration . - Scripts of educational design with Kidspiration .
5	-Digital narration .	- WeVideo . - Creating digital stories .
6	Educational robotics . - Bee - Bot - Blue - Bot -Probot	- WeVideo . - Creating digital stories .
7	Educational robotics . - Bee - Bot - Blue - Bot -Probot	- Learning activities with WeVideo .
8	- Games and quizzes .	-Educational robotics with Lego WeDo .
9	-Games and quizzes .	-Educational robotics with Lego WeDo .
10	- Integration of microcosms , modeling and simulations into the learning process .	- Learning activities with Microworlds Jr.
11	- Integration of microcosms , modeling and simulations into the learning process .	- Learning activities with Microworlds Jr.
12	- Integration of microcosms , modeling and simulations into the learning process .	- Learning activities with Microworlds Jr.
13	- Review .	- Review .

1.1B. CYPRUS CASE STUDY: DESIGN TASK

Εκπαιδευτική Τεχνολογία-ΕΠΑ 138
Τμήμα Επιστημών της Αγωγής
Πανεπιστήμιο Κύπρου
Χειμερινό 2017

ΕΡΓΑΣΙΑ 1η

Η Αξιοποίηση του Λογισμικού Kidspiration στο Αναλυτικό Πρόγραμμα της Δημοτικής/Προδημοτικής Εκπαίδευσης

Ημερομηνία Υποβολής Εργασίας για Βαθμολόγηση: 25/10/2017 (ΔΗΜ), 26/10/2017 (ΠΡΟ)

Τι θα υποβάλετε για βαθμολόγηση:

1) Ένα σχέδιο αξιοποίησης του λογισμικού Kidspiration στη μαθησιακή διαδικασία (σε έντυπη μορφή και σε ηλεκτρονική μορφή σε word document) το οποίο να έχει έκταση γύρω στις τέσσερις δακτυλογραφημένες σελίδες (1.5 διάστιχο, 12 point, Times New Roman, περιθώρια 1 ίντσα σε όλες τις πλευρές).
2) Τις δραστηριότητες του Kidspiration σε memory stick (usb) και σε screen shots στο word document. Να ονομάσετε τα αρχεία σας στο kidspiration ως ακολούθως: activity1, activity2, activity3, κλπ. Να ονομάσετε το word document με το επίθετό σας (στα αγγλικά) και τον αριθμό της ταυτότητας σας (π.χ., Georgiou_956734).

Οδηγίες

1. Το σχέδιο ενσωμάτωσης που θα υποβάλετε για βαθμολόγηση πρέπει να έχει την δομή που συζητήσαμε στη διάλεξη και για την οποία έχετε λεπτομερείς σημειώσεις.
2. Να επιλέξετε ένα θέμα κατάλληλο για ενσωμάτωση του Kidspiration στο αναλυτικό πρόγραμμα της δημοτικής/προδημοτικής εκπαίδευσης εκτός θέματα που αφορούν τη φυσική αγωγή, τις αισθήσεις, τις ψυχοκινητικές δεξιότητες και την εικαστική έκφραση.
3. Οι φοιτητές της δημοτικής να επιλέξουν μίαν τάξη από τον Κύκλο Α' (κατώτερη δημοτική εκπαίδευση). Οι φοιτητές της προδημοτικής να επιλέξουν την προδημοτική τάξη.
4. Να αναφέρετε τη σελίδα από το βιβλίο των αναλυτικών προγραμμάτων στην οποία γίνεται αναφορά του θέματος που έχετε επιλέξει.
5. Οι δραστηριότητές σας πρέπει να σχεδιαστούν με **βάση τη θεωρία του οικοδομισμού.**
6. Ο αριθμός των δραστηριοτήτων με το Kidspiration να είναι το λιγότερο πέντε (3 στο στάδιο της οικοδόμησης, 1 στο στάδιο της διάγνωσης, 1 στο στάδιο της αποσταθεροποίησης). Όλες οι δραστηριότητες στο Kidspiration να βρίσκονται σε παράρτημα (Screen shots) στο word document.
7. Να περιγραφούν και όλες οι άλλες δραστηριότητες που θα γίνουν χωρίς το Kidspiration.
8. Να υποθέσετε ότι οι μαθητές γνωρίζουν τα λογισμικά προγράμματα.
9. Να υποθέσετε ότι έχετε 1 Η/Υ για κάθε 2 μαθητές/τριες.
10. Δεν θα επιστραφούν τα σχέδια αξιοποίησης επομένως να κάνετε ένα αντίγραφό της εργασίας σας.

[redacted]

ΕΠΑ 138

Αναλυτική περιγραφή του σχεδίου μαθήματος με βάση το οικοδομιστικό μοντέλο

1.Θέμα και αιτιολόγηση της επιλογής του

Θα πρέπει να φτιάξετε μια παράγραφο με τις απαντήσεις των πιο κάτω ερωτήσεων:

- Ποιο είναι το θέμα;
- Σχέση του θέματος με το βιβλίο αναλυτικών προγραμμάτων (π.χ., στο βιβλίο της γλώσσας, σελ 53)
- Γιατί διάλεξα να ασχοληθώ με αυτό το θέμα; (Γιατί να ενδιαφέρει τα παιδιά; Γιατί είναι χρήσιμο/αναγκαίο να γνωρίζουν τα παιδιά πληροφορίες για αυτό το θέμα; Γιατί χρειάζεται τεχνολογία; -- - Τι είδους αναπαραστάσεις και διδακτικές μέθοδοι θα χρησιμοποιηθούν για το μετασχηματισμό του περιεχομένου; Ποιές οι παρανοήσεις ή οι εναλλακτικές αντιλήψεις για αυτό το θέμα;)
- Ποιές οι τεχνικές λειτουργίες του λογισμικού και οι εκπαιδευτικές του δυνατότητες (affordances) που το καθιστούν κατάλληλο για την διδασκαλία του θέματος;

2.Τάξη

3. Διάρκεια

4. Σύντομη περιγραφή περιεχομένου

Σε αυτό το σημείο θα πρέπει να αναφέρετε τις έννοιες που θα διδαχθούν και τι θα διδαχθεί για την κάθε μια έννοια.

5. Μαθησιακοί στόχοι

Το παιδί να:….

5.1 Γνωσιολογικοί (περιεχομένου)
5.2 Δεξιότητες Ανώτερου επιπέδου
5.3. Στόχοι πληροφορικής

6. Πορεία – Μαθησιακές δραστηριότητες

Σε κάθε βήμα γράφετε: ποιες δραστηριότητες γίνονται, ποιος είναι ο ρόλος των παιδιών, της/του εκπαιδευτικού και του Η/Υ, πού βρίσκεται η προστιθέμενη αξία της χρήσης των ΤΠΕ (όπου αυτές χρησιμοποιούνται).

6.1 Αφόρμηση (Σενάριο)

[redacted]

ΕΠΑ 138

Αποτελεί το πρώτο στάδιο του οικοδομιστικού μοντέλου κατά το οποίο η εκπαιδευτικός θα πρέπει να εισαγάγει τα παιδιά στο μάθημα, διεγείροντας τους το ενδιαφέρον και θέτοντας κάποιους προβληματισμούς που αποτελούν το έναυσμα του μαθήματος.

6.2 Διάγνωση αρχικών αντιλήψεων

Κατά την διάρκεια του σταδίου αυτού, μέσα από μαθησιακές δραστηριότητες ή και με οποιονδήποτε άλλο τρόπο, η εκπαιδευτικός καλείται να διαγνώσει τις αρχικές αντιλήψεις των παιδιών/μαθητών της στο συγκεκριμένο θέμα. Τα παιδιά/μαθητές ενίοτε έχουν παρανοήσεις ή εναλλακτικές αντιλήψεις που τους προκαλούν συγχύσεις και αποκτούν λανθασμένη εικόνα για τον κόσμο γύρω τους. Λόγω χάρη τα παιδιά πολλές φορές πιστεύουν ότι η βροχή προέρχεται από τρύπες που υπάρχουν στα σύννεφα.

6.3 Αποσταθεροποίηση αρχικών αντιλήψεων

Επομένως είναι αρκετά σημαντικό να αποσταθεροποιηθούν οι αρχικές αντιλήψεις των παιδιών/μαθητών, εφόσον είναι λανθασμένες, για την δημιουργία των γνωστικών τους σχημάτων. Αποσταθεροποίηση ουσιαστικά σημαίνει ότι το ίδιο το παιδί αντιπαραβάλλει τις λανθασμένες αντιλήψεις που έχει για τον κόσμο γενικότερα με αυτές που πραγματικά ισχύουν, κάτι που το φέρνει σε μία αμήχανη θέση. Με αυτόν τον τρόπο συντελείται η γνωστική σύγκρουση δηλαδή τη σύγκρουση ανάμεσα σ' αυτό που το παιδί προβλέπει να συμβεί και σ' εκείνο που στην πραγματικότητα συμβαίνει. Αποτελεί κύριο μηχανισμό αναδιοργάνωσης της γνώσης.

6.4 Οικοδόμηση νέας γνώση

Η οικοδόμηση της νέας γνώσης είναι το σημαντικότερο στάδιο του οικοδομιστικού μοντέλου μάθησης γιατί σε αυτό συντελείται η απόκτηση νέων γνώσεων. Μέσα από ένα σύνολο μαθησιακών προσεγγίσεων που θα πρέπει να πλαισιώνονται από την τεχνολογία, η εκπαιδευτικός αποσκοπεί στο να επιτευχθούν οι μαθησιακοί στόχοι που έχει θέσει στην αρχή του σχεδίου μαθήματός της.

6.5 Εφαρμογή νέων γνώσεων

Η εφαρμογή των νέων γνώσεων που αποκτήθηκαν στο προηγούμενο στάδιο πρέπει να γίνει σε ένα διαφορετικό/αυθεντικό πλαίσιο ούτως ώστε να επιτευχθεί η εμπέδωση των νέων γνώσεων.

6.6 Ανασκόπηση και σύγκριση με αρχικές ιδέες

Με το στάδιο αυτό ολοκληρώνεται το σχέδιο μαθήματος αφού ανακεφαλαιώνονται οι βασικές έννοιες του μαθήματος και συζητούνται οι αρχικές αντιλήψεις των παιδιών/μαθητών.

7. Τελική αξιολόγηση. Σε αυτό το σημείο η αξιολόγηση μπορεί να πάρει διάφορες μορφές, όπως εξεταστικά δοκίμια και φύλλα εργασίας ή KAHOOT!.

Educational technology 138
Department of Education Sciences
University of Cyprus
Semester 2017

Assignment 1
The use of Kidspiration software in the curriculum of studies in Primary Education and Childhood Sciences.
Date of delivery of the work for the final evaluation: 25/10/2017 (Primary education), 26/10/2017 (Pre-primary education)

Documentation required for evaluation
1) A design using the Kidspiration software in the learning phase (in printed form and in electronic word format) of about four typed pages (line spacing 1.5, font size 12, Times New Roman font, margin 1cm).
2) Kidspiration activities in a memory card (usb) and in screen shots in a word document. The archives in the Kidspiration software should be renamed as follows: activity 1, 2, 3 etc. The word document must be renamed with its surname (in Latin characters) and its identification number (for example, George_956734).

Instructions
1. The design product to be submitted for evaluation must have the structure discussed at the lesson and for which precise indications have been given.
2. A suitable theme for the incorporation of Kidspiration into the primary and pre-primary education curriculum must be chosen. That does not address natural education, the senses, psychokinetic abilities and artistic expression.
3. Primary school future teachers should choose a class from cycle A' (lower primary education), while kindergarten future teachers should choose a class from their cycle.
4. In the page of the curricula there must be a reference to the theme that has been chosen.
5. The activities must be planned on the basis of the theory of constructivism.
6. The activities with Kidspiration must be no less than five (three in the constructivism phase, one in the diagnosis phase, one in the destabilization phase). All the activities with Kidspiration can be found in the appendix (screen shots) in the word document.
7. All the activities that will be done without Kidspiration must be described.
8. Pupils are assumed to be familiar with the software.
9. Assume that there is one computer for every two or three students.
10. Evaluated products will not be returned, so it is recommended to make a copy.

Analytical description of the lesson plan based on the traditional model

1. Subject and justification of the choice
   You should make a paragraph with the answers to the questions below:
   - Which is the subject?
   - Relationship of the subject with the program book (e.g. in the book of language, p. 53)
   - Why did I choose to deal with this issue? (why does this interest students? Why is it necessary/useful for the students to know about this subject? Why is technology needed? What representations and teaching methods will be used to transform the content? What misunderstandings or alternative perceptions are there on this issue?)
   - What technical functions of the software and its affordances make it appropriate for teaching the subject?

2. Classroom

3. Duration

4. Brief description of the content
   (at this point you should indicate the concepts to be taught and what will be learned for each concept)

5. Learning objectives

The student will develop

- Cognitive skills (content)
- Higher level skills
- IT objectives

6. Course/learning activities

   In each step you should write: what activities are being done, what is the role of the students, the teacher and the computer; which is the added value of using ICT (when/where they're used)

   6.1. Motivation (scenario)

   This is the stage of the model in which the teacher should introduce the child into the course, stimulating the interest and raising some concerns that are the starting point of the course

   6.2. Diagnose initial conceptions

   During this stage, through learning activities or in any other way, the educator is asked to diagnose the original perceptions or alternative perceptions that confuse them and they get the wrong picture of the world around them. Because children many times believe that rain comes from holes in the clouds (??)

   6.3. Destabilizing original conceptions

   It is therefore important to destabilize the original perception of students, if they are wrong, and to create cognitive maps (?).

   Destabilizing, in essence, means that the child himself contrasts his misconceptions about the world in general with those actually in place, something that puts it in an embarrassing position. In this way the cognitive conflict, that means, the conflict between what the child predicts to happen and what is actually happening. It is a major mechanism for the reorganization of knowledge.

   6.4. Building new knowledge

   The building of new knowledge is the most important stage of the learning model, because it is the acquisition of new knowledge. Through a set of learning approaches that should be supported by technologies, the teacher aims to achieve the learning objectives that she has set at the beginning of her curriculum

   6.5. Application of new knowledge

   The application of the new knowledge acquired at the previous stage must be made in a different way

   6.6. Reviewing and comparing with original ideas

   This stage completes the course by recapitalizing the basic concepts of the course and children's initial perceptions are discussed.

7. Final assessment

   At this point the assessment can take several forms, such as test papers and worksheets.

1.1C. CYPRUS CASE STUDY: DESIGN RUBRIC

ΕΠΑ 138
Χαρούλα Αγγελή, Άντρη Χριστοδούλου

ΠΑΝΕΠΙΣΤΗΜΙΟ ΚΥΠΡΟΥ
ΤΜΗΜΑ ΕΠΙΣΤΗΜΩΝ ΤΗΣ ΑΓΩΓΗΣ
ΕΚΠΑΙΔΕΥΤΙΚΗ ΤΕΧΝΟΛΟΓΙΑ
ΧΕΙΜΕΡΙΝΟ ΕΞΑΜΗΝΟ
2017-2018

Δελτίο Αξιολόγησης Πρώτης Εργασίας (Kidspiration)

Όνομα:
Βαθμός:
Υπογραφή:

Κριτήριο	Βαθμολογία	Βαθμός
1. Θέμα και σκεπτικό καταλληλότητας του Kidspiration για τη διδασκαλία του θέματος	5	
2. Σύντομη περιγραφή περιεχομένου (10 γραμμές)	5	
3. Στόχοι (κατώτερο επίπεδο και πληροφορικής)	5	
4. Δραστηριότητες	(35)	
4.1 Αφόρμηση/Διέγερση ενδιαφέροντος	5	
4.2 Αρχικές αντιλήψεις	5	
4.3 Αποσταθεροποίηση	5	
4.4 Οικοδόμηση (εκφράζεται, διερευνά, παίρνει αποφάσεις, συνεργάζεται, ανακαλύπτει κλπ)	10	
4.5 Εφαρμογή	5	
4.6 Σύγκριση αρχικών/νέων ιδεών	5	
5. Προστιθέμενη αξία του Kidspiration στις μαθησιακές δραστηριότητες	10	
ΣΥΝΟΛΟ	60	

EDUCATIONAL TECHNOLOGY
Primary Education
WINTER SEMESTER
2017 -2018

Evaluation rubric of the design product (Kidspiration)

Name:
ID number:
Signature:

Criterion	Ratings	Degree
1. Topic and rationale of software relevance for teaching the subject matter	5	
2. Short description of content (10 lines)	5	
3. Objectives	5	
4. Activities	(35)	
4.1. Motivation/stimulation of interest	5	
4.2. Initial perceptions	5	
4.3. Destabilization of preconceptions	5	
4.4. Building knowledge (expressing, exploring, making decisions, collaborating, discovering etc.)	10	
4.5. Application of new knowledge	5	
4.6. Comparison of original/new ideas	5	
5. Added value of software in learning activities	10	
TOTAL	60	

1.2A. ITALY CASE STUDY: COURSE SUMMARY

Retrieved at https://didattica.unipd.it/off/2017/CU/SU/IA1870/000ZZ/SFO2043316/N0

Corsi di Laurea Magistrale a Ciclo Unico

Scuola di Scienze umane, sociali e del patrimonio culturale
SCIENZE DELLA FORMAZIONE PRIMARIA

Insegnamento
METODOLOGIE E DIDATTICHE E TECNOLOGIE PER LA DIDATTICA SFO2043316, A.A. 2018/19

Informazioni valide per gli studenti immatricolati nell'A.A. 2017/18

Principali informazioni sull'insegnamento

Corso di studio
Laurea magistrale ciclo unico 5 anni in SCIENZE DELLA FORMAZIONE PRIMARIA (Ord. 2017) IA1870, ordinamento 2017/18, A.A. 2018/19

Crediti formativi
11.0

Tipo di valutazione
Voto

Denominazione inglese
METHODOLOGIES, DIDACTICS AND TECHNOLOGIES FOR TEACHING

Dipartimento di riferimento
Dipartimento di Filosofia, Sociologia, Pedagogia e Psicologia Applicata (FISPPA)

Obbligo di frequenza
No

Lingua di erogazione
ITALIANO

Sede
PADOVA

Corso singolo
NON è possibile iscriversi all'insegnamento come corso singolo

Corso a libera scelta
Insegnamento riservato SOLO agli iscritti al corso di SCIENZE DELLA FORMAZIONE PRIMARIA (Ord. 2017)

Docenti

Responsabile

[redacted]

Syllabus

Prerequisiti:

Elementi di base di didattica generale; competenze informatiche di base.

Conoscenze e abilità da acquisire:

Gli studenti acquisiranno: conoscenze teoriche di base utili per costruire una intelaiatura concettuale che consenta loro, in prospettiva long life, di integrare saperi metodologico-didattici e saperi tecnologici mettendoli in relazione con i saperi racchiusi nei campi di esperienza e nei domini disciplinari; procedure per tradurre operativamente i saperi integrati e per valutare l'integrazione delle tecnologie e le tecnologie stesse; abilità per la costruzione integrata di piani d'intervento didattico usando coerentemente format, metodologie, tecniche, strategie e tecnologie.

PARTE I - (4+1 CFU laboratorio), seminario-laboratoriale (1 CFU).

- Le politiche educative europee e nazionali e i piani ministeriali in materia di formazione e tecnologie; gli orientamenti attuali volti a ridefinire la competenza digitale;
- le teorizzazioni sui saperi pedagogico-metodologico-didattici (modelli, approcci metodologici, format)
- le specificità delle metodologie didattiche nella scuola primaria e dell'infanzia (tecniche di conduzione, strategie, strumenti);
- le linee di ricerca sull'integrazione delle ICT nella formazione degli insegnanti.

Conoscenze e abilità saranno opportunamente graduate per la scuola dell'infanzia e la scuola primaria.

PARTE II – (4CFU + 1 CFU laboratorio).

- Le teorie e le procedure per operazionalizzare l'integrazione delle ICT nella scuola primaria e dell'infanzia;
- le potenzialità delle nuove tecnologie per la costruzione di ambienti d'apprendimento integrati (dall'uso della LIM ai software didattici specifici);
- reperimento risorse digitali per la didattica e costruzione di mappe per descrizione e analisi (attività online per 6 ore);
- approcci metodologico-tecnologici: il DST; Scratch; didattica con la LIM; Flipped Classroom; Gamification, piattaforme per la didattica.
- le teorie e le procedure valutative inerenti all'integrazione delle ICT.

Conoscenze e abilità saranno opportunamente graduate per la scuola dell'infanzia e la scuola primaria.

Abilità. Attraverso le attività seminariali e il laboratorio (I e II parte) gli studenti dovranno acquisire le seguenti abilità:

- riflessione guidata per la progettazione di piani d'intervento didattico (unità di lavoro): dai traguardi di competenza agli obiettivi d'apprendimento; scelta di modelli, metodi, format, tecniche e strategie, ICT.
- costruzione di piani d'intervento didattico (unità di lavoro), integrando nella progettazione ICT, tipi di attività, forme di conoscenza, modalità di rappresentazione della conoscenza.

Le attività di laboratorio saranno organizzate in due fasi (I parte novembre II parte gennaio) per cui sarà necessario che la composizione dei gruppi rimanga costante.

L'attività seminariale in plenaria si svolgerà in due giornate intensive nel periodo di novembre.

Si ricorda che la frequenza ai laboratori e al seminario è obbligatoria.

Modalità di esame:

Prova scritta finale sui testi in Bibliografia (testo comune per tutti + parte differenziata su testo a scelta) comprensiva degli argomenti affrontati nella I Parte e nella II Parte.

La prova scritta finale consiste in domande di tipo definitorio o riflessivo a risposta chiusa o aperta.

Prove di laboratorio, collegate alla I Parte e alla II Parte, consistenti nella progettazione di unità di apprendimento, secondo le teorie apprese durante le due parti dell'insegnamento.

Criteri di valutazione:

La valutazione complessiva è calcolata con media ponderata (8 CFU per l'insegnamento; 1 CFU per il Laboratorio I Parte, 1 CFU per il Laboratorio II Parte; il seminario laboratoriale di 1 CFU collegato alla I Parte non sarà oggetto di valutazione).

Criteri di valutazione dalla prova scritta (70%):

- attinenza delle risposte alle domande;
- esaustività delle risposte;
- proprietà terminologica.

Criteri di valutazione del prodotto di laboratorio della I Parte (15%):

-coerenza tra gli elementi di progettazione;

-correttezza terminologica;

-completezza dell'elaborazione progettuale.

Criteri di valutazione del prodotto di laboratorio della II Parte (15%):

-coerenza tra gli elementi di progettazione;

-correttezza terminologica;

-completezza dell'elaborazione progettuale.

Contenuti:

PARTE I

MODULO 1. Politiche educative europee e nazionali: formazione e tecnologie; orientamenti attuali sulla competenza digitale.

MODULO 2. Teorie sui saperi disciplinari: conoscenza psico-pedagogica delle discipline; trasposizione didattica.

MODULO 3. Teorie sui saperi pedagogico-metodologico-didattici: conoscenza pedagogica; conoscenza metodologico-didattica; concetti di metodo, metodologia, modello, format, tecniche e strategie didattiche; orientamenti metodologici e modelli; comunicazione didattica e innovazione tecnologica.

MODULO 4. Concettualizzazioni sulle tecnologie: scenario tecnologico; tipi di tecnologie; tratti didattici delle tecnologie e degli applicativi Web 2.0 (DST, Scratch; LIM; Flipped, Classroom, Gamification, piattaforme per la didattica); funzioni d'uso educative delle tecnologie; tecnologie e domini disciplinari; ambienti di apprendimento; documentazione narrativa digitale.

MODULO 5: Seminario laboratoriale coordinato dalla docente sull'uso strategico di metodologie, tecniche e strumenti

per la realizzazione di progetti didattico-educativi ed unità d'apprendimento.
MODULO 6: Attività laboratoriali (I parte) in gruppo con max 30 studenti, coordinate dalla docente e condotte da tutor esperti per la costruzione e simulazione di percorsi didattici ed educativi utilizzando metodologie e strumenti specifici.

PARTE II
MODULO 1. Linee di ricerca sull'integrazione delle tecnologie nella formazione degli insegnanti: tendenze di ricerca; modelli per integrare le tecnologie nella formazione iniziali.
MODULO 2. Modelli teorici sull'integrazione dei saperi di base: TPACK; TPCK e ICT; TPCK e Web; affordance e ICT; TPACK e discipline,; TPACK, apprendimento e contesto culturale; ICT e trasposizione didattica;
MODULO 3. Procedure per operazionalizzare l'integrazione: processo di adozione delle tecnologie; tipi di attività e forme di conoscenza; modalità di rappresentazione della conoscenza; ruolo delle affordance nella multimodalità di rappresentazione della conoscenza e incidenza del contesto e delle specificità degli studenti;
MODULO 4. Procedure per valutare l'integrazione: strumenti per valutare la competenza di insegnamento con le tecnologie; tecnologie per la valutazione; coordinate per la valutazione; valutazione delle risorse didattiche digitali.
MODULO 5: Attività laboratoriali (II parte), coordinate dalla docente e condotte da tutor esperti, finalizzate alla integrazione delle tecnologie nella progettazione educativa e didattica.
Attivita' di apprendimento previste e metodologie di insegnamento:
Parte I- prevede l'integrazione fra lezioni teoriche, seminari di approfondimento ed esperienze di laboratorio. Le lezioni (30 ore) saranno condotte con modalità dialogiche e interattive, esercitazioni e lavori di gruppo in piattaforma MOODLE. Il seminario laboratoriale interno (Modulo 5, 1 CFU), obbligatorio per frequentanti e non frequentanti è condotto dalla docente ed è finalizzato all'approfondimento sull'uso strategico di metodi,format e tecniche.
Il laboratorio esterno alle lezioni (Modulo 6, 1 CFU), obbligatorio per frequentanti e non frequentanti, sarà svolto attivando strategie d'apprendimento a carattere costruttivo, metacognitivo e collaborativo volte a favorire la partecipazione attiva da parte dello studente.
I laboratori proporranno attività di simulazione e costruzione di percorsi didattici ed educativi utilizzando specifici modelli, metodi, format, tecniche e strategie.

PARTE II- prevede l'integrazione fra lezioni teoriche e attività di laboratorio. Le lezioni (24 + 6 h. attività in piattaforma) si svolgeranno con modalità partecipative e ad esse saranno accostate esercitazioni e lavori di gruppo in piattaforma MOODLE.
Il laboratorio (1 CFU) è dedicato a integrare operativamente le tecnologie nella progettazione didattica ed è obbligatorio per frequentanti e non frequentanti.
Eventuali indicazioni sui materiali di studio:
Per frequentanti e non frequentanti potranno essere messi a disposizione altri materiali di studio attraverso la piattaforma MOODLE o indicati testi di approfondimento.

Testi di riferimento:

- Messina, L., & De Rossi, M., Tecnologie, formazione e didattica. Roma: Carocci, 2015. *testo obbligatorio*
- Petruccco, C., De Rossi, M., Narrare con il Digital Storytelling a scuola e nelle organizzazioni. Roma: Carocci, 2009. *in alternativa*
- Bonaiuti, G., Didattica attiva con la LIM. Metodologie, strumenti e materiali. Trento: Erickson, 2009. *in alternativa*
- Sacchi I., Attività di coding nella scuola primaria. Formato Kildle: Amazon Media EU, 2017. *in alternativa*

Master's Degree Course

School of Humanities, Social Sciences and Cultural Heritage
PRIMARY EDUCATION SCIENCES

MEHODOLOGIES, DIDACTICS AND TECHNOLOGIES FOR TEACHING
[redacted], P.A. 2018/19

Valid information for students enrolled in the A.A. 2017/18

Main information on teaching
Course of study
Master's degree single cycle 5 years in
SCIENCES OF PRIMARY TRAINING (Ord. 2017)
IA1870, Sorting 2017/18, A.O. 2018/19

Main information on the course

Course
Laurea magistrale ciclo unico 5 anni in
SCIENZE DELLA FORMAZIONE PRIMARIA (Ord. 2017)
IA1870, ordinamento 2017/18, A.A. 2018/19

Master's degree single cycle 5 years in
SCIENCES OF PRIMARY TRAINING (Ord. 2017)
IA1870, Sorting 2017/18, A.O. 2018/19

Training credits
11.0

Type of evaluation
Mark

English name
MEHODOLOGIES, DIDACTICS AND TECHNOLOGIES FOR TEACHING

Department of reference
Department of Philosophy, Sociology, Pedagogy and Applied Psychology (FISPPA)

Frequency obligation
No.

Language of delivery
ITALIAN

Headquarter
PADUA

Single course
It is NOT possible to enrol in the course as a single course

Course of your choice
Teaching reserved ONLY for students enrolled in the course of SCIENCES OF PRIMARY EDUCATION (Ord. 2017)

Professor

Responsible

[redacted]

Syllabus

Prerequisites:

Basic elements of general education; basic computer skills.

Knowledge and skills to be acquired:

Students will acquire: basic theoretical knowledge useful to build a conceptual framework that allows them, in a long life perspective, to integrate methodological-didactic knowledge and technological knowledge by relating them to the knowledge contained in the fields of experience and disciplinary domains; procedures to translate integrated knowledge operationally and to assess the integration of technologies and the technologies themselves; skills for the construction of integrated plans of educational intervention using consistent formats, methodologies, techniques, strategies and technologies.

PART I - (4+1 CFU laboratory), workshop seminar (1 CFU).

- European and national educational policies and ministerial plans on training and technologies; current guidelines to redefine digital competence;
- theories on pedagogical-methodological-didactic knowledge (models, methodological approaches, formats)
- the specificities of teaching methodologies in primary and kindergarten (leadership techniques, strategies, tools);
- research lines on the integration of ICT in teacher training.

Knowledge and skills will be appropriately graded for kindergarten and primary school.

PART II - (4CFU + 1 CFU laboratory).

- Theories and procedures for operationalizing the integration of ICT in primary and kindergarten;
- the potential of new technologies for building integrated learning environments (from the use of interactive whiteboard to specific educational software);
- finding digital resources for teaching and building maps for description and analysis (online activities for 6 hours);
- methodological-technological approaches: the DST; Scratch; teaching with the LIM; Flipped Classroom; Gamification, platforms for teaching.
- Theories and evaluation procedures related to ICT integration.

Knowledge and skills will be appropriately graded for kindergarten and primary school.

Skills. Through the seminar activities and the workshop (I and II part) students will have to acquire the following skills:

- guided reflection for the design of didactic intervention plans (work units): from competence goals to learning objectives; choice of models, methods, formats, techniques and strategies, ICT.
- construction of didactic intervention plans (work units), integrating in the ICT design, types of activities, forms of knowledge, ways of representing knowledge.

The laboratory activities will be organized in two phases (I part November II part January) so it will be necessary that the composition of the groups remains constant.

The plenary seminar will take place in two intensive days during the period of November.

Please note that attendance at the workshops and the seminar is mandatory.

Examination procedure:

Final written test on the texts in Bibliography (common text for all + differentiated part on text of your choice) including the topics covered in Part I and Part II.

The final written test consists of questions of a definitory or reflexive type with a closed or open answer.

Laboratory tests, related to Part I and Part II, consisting of the design of learning units, according to the theories learned during the two parts of the teaching.

Evaluation criteria:

The overall assessment is calculated with a weighted average (8 CFUs for teaching; 1 CFU for Laboratory I Part, 1 CFU for Laboratory II Part; the laboratory seminar of 1 CFU connected to the I Part will not be subject to assessment).

Evaluation criteria from the written test (70%):

- relevance of the answers to the questions;
- exhaustiveness of the answers;
- terminological properties.

Criteria for evaluation of the laboratory product of Part I (15%):

-Consistency between design elements;

-Correctness of terminology;

-Completeness of design elaboration.

Criteria for evaluation of the laboratory product of Part II (15%):

-Consistency between design elements;

-Correctness of terminology;

-Completeness of the design process.

Contents:

PART I

MODULE 1. European and national education policies: training and technologies; current guidelines on digital competence.

MODULE 2. Theories on disciplinary knowledge: psycho-pedagogical knowledge of disciplines; didactic transposition.

MODULE 3. Theories on pedagogical-methodological-didactic knowledge: pedagogical knowledge; methodological-didactic knowledge; concepts of method, methodology, model, format, techniques and didactic strategies; methodological orientations and models; didactic communication and technological innovation.

MODULE 4. Technology conceptualizations: technological scenario; types of technologies; didactic traits of Web 2.0 technologies and applications (DST, Scratch; LIM; Flipped, Classroom, Gamification, educational platforms); educational use functions of technologies; disciplinary technologies and domains; learning environments; digital narrative documentation.

MODULE 5: Workshop coordinated by the teacher on the strategic use of methodologies, techniques and tools for the implementation of educational projects and learning units.

MODULE 6: Workshop activities (Part I) in group with max 30 students, coordinated by the teacher and conducted by expert tutors for the construction and simulation of didactic and educational paths using specific methodologies and tools.

PART II

MODULE 1. Research lines on the integration of technologies into teacher training: research trends; models for integrating technologies into initial training.

MODULE 2. Theoretical models on the integration of basic knowledge: TPACK; TPCK and ICT; TPCK and Web; affordance and ICT; TPACK and disciplines; TPACK, learning and cultural context; ICT and didactic transposition;

MODULE 3. Procedures to operationalize integration: process of adoption of technologies; types of activities and forms of knowledge; modes of knowledge representation; role of affordances in multimodality of knowledge representation and impact of context and specificity of students;

MODULE 4. Procedures to evaluate integration: tools to evaluate teaching competence with technologies; technologies for evaluation; coordinates for evaluation; evaluation of digital teaching resources.

MODULE 5: Laboratory activities (part II), coordinated by the teacher and conducted by expert tutors, aimed at the integration of technologies in educational and didactic design.

Learning activities and teaching methodologies:

Part I - provides for the integration of theoretical lessons, seminars and laboratory experiences. The lessons (30 hours) will be conducted in a dialogical and interactive way, with exercises and group work on the MOODLE platform. The internal workshop seminar (Module 5, 1 CFU), compulsory for both students and non-attendants, is conducted by the teacher and is aimed at deepening the strategic use of methods, formats and techniques.

The laboratory outside the lessons (Module 6, 1 CFU), compulsory for students and non-attendants, will be carried out by activating constructive, metacognitive and collaborative learning strategies aimed at encouraging active participation by the student.

The workshops will propose activities of simulation and construction of didactic and educational paths using specific models, methods, formats, techniques and strategies.

PART II - provides for the integration of theoretical lessons and laboratory activities. The lessons (24 + 6 h. platform activities) will take place in a participatory manner and will be combined with exercises and group work in MOODLE platform.

The laboratory (1 CFU) is dedicated to the operational integration of technologies in educational design and is mandatory for both frequent and non-attending students.

Possible indications on the study materials:

For visitors and non-goers, other study materials can be made available through the MOODLE platform or indicated in-depth texts.

References:

- Messina, L., & De Rossi, M., Tecnologie, formazione e didattica. Roma: Carocci, 2015. *mandatory*

- Petruccco, C., De Rossi, M., Narrare con il Digital Storytelling a scuola e nelle organizzazioni. Roma: Carocci, 2009. *eligible*
- Bonaiuti, G., Didattica attiva con la LIM. Metodologie, strumenti e materiali. Trento: Erickson, 2009. *eligible*
- Sacchi I., Attività di coding nella scuola primaria. Formato Kildle: Amazon Media EU, 2017. *eligible*

1.2B. ITALY CASE STUDY: DESIGN TASK

La Scheda prevede 2 indicatori dati e 9 indicatori aperti e ha lo scopo di guidare gli studenti del *Laboratorio di Metodologie didattiche* a progettare una unità di apprendimento acquisendo padronanza soprattutto degli indicatori specifici di Metodologie didattiche, cioè: 6, 6.1, 6.2, 6.3, 6.4 .

1.Contesto classe/ambiente/studenti								
2.Traguardi di apprendimento/obiettivi								
3.Tempi	**4.Contenuto/ Argomento**	**5.Conoscenze/ Abilità**	**6.Approccio/i didattico/i-Modelli**	**6.1. Metodi**	**6.2. Format**	**6.3. Strategie**	6.4. **Tecniche**	**11.Verifica e Valutazione**

7. Tecnologie	**8. Tipi di attività**	**9.Forme di conoscenza**	**10. Multimodalità**

The task provides 2 indicators and leaves 9 open to fulfil. It has the aim of guiding students of the Teaching Methodology Workshop in designing a learning unit, developing especially their competences in teaching methodologies, found at 6, 6.1, 6.2, 6.3, 6.4.

1. Context / Environment / Students								
2.Goals/objectives								
3.Timeframe	**4. Content/ Topic**	**5.Knowledge / Skills**	**6. Teaching approach(es) - models**	**6.1. Methods**	**6.2. Format**	**6.3. Strategies**	**6.4. Techniques**	**11. Evaluation and assessment**

7. Technologies	**8. Activity types**	**9.Forms of knowledge**	**10. Multimodality**

1.2C. ITALY CASE STUDY: DESIGN RUBRIC

Indicatori	**Giudizi e voti**
1. *Indicatori di prodotto di gruppo (piano della lezione e/o intervento didattico)* 1.1 Completezza delle parti 1.2. Coerenza tra le parti 1.3. Qualità delle integrazioni, degli approfondimenti e della ricerca di materiale svolta in maniera autonoma 1.4. Pianificazione e modalità di presentazione	• Ottimo (completo, coerente tra le parti, presenti approfondimenti sulle tecniche) 28-30 • Buono (completo, coerente tra le parti, descrizione delle tecniche) 24-27 • Sufficiente (completo, coerente) 18-23 • Non sufficiente (incompleto, incoerente)

Criterion	Mark and evaluation
Indicators of group work (design product and/or learning unit) e) Completeness of parts f) Coherence among parts g) Quality of technology integration, autonomous study and research of materials h) Presentation skills	Very good (complete, consistent, in-depth analysis of teaching techniques) 28-30 Good (complete, consistent between parts, description of teaching techniques) 24-27 Sufficient (complete, consistent) 18-23 Not sufficient (incomplete, inconsistent) <18

1.3A. The Netherlands case study: course summary

Rooster minor Learning and ICT 2017-2018

Overview

college	week	Pilot- P roject *	Research	Reflection	Remaining...
1	Mon 29 Jan	Analysis		Vision	
2	Mon 5 Feb.	Analysis	Research question		IPON - fair
3	Mon 12 Feb.	Design	Plan of action	Brainstorm	
4	Mon 19 Feb.	Design	Research plan		Consult
X	Mon 26 Feb.	-			
5	Mon 5 Mar.	Development	Theory	Cycle 1	Exam
6	Mon 12 Mar.	Implementation	Theory practice	Moment 1	Consult
7	Mon Mar 19	Evaluation			Presentations
T1	Mon 26 Mar.	Evaluation →			
T2	Mon 2 Apr	→ Analysis (2)	Method		
8	Mon 9 apr	Analysis		Moment 2	Consult
9	Mon 16 apr	Design			
10	Mon 23 Apr	Development	Instruments	Cycle 2	Consult
X	Mon 30 apr	-			
11	Mon 7 May	Implementation	Collecting data	Moment 3	Do free -Helping
12	Ma May 14	Implementation			Consult
13	Mon 21 May	Evaluation	Reporting		Mon free -Pinking
14	Mon, May 28	Evaluation		Moment 4	Presentations
T1	Mon, June 4	Evaluation →	Conclusion		Consult
T2	Ma June 11	→ Analysis (3)		Outflow profile	

* we go through the ADDIE phases twice.

At the end of each week is what you have to study in any case for the next week.

Belangrijke ingrediënten binnen deze minor: -gericht op duurzame vaardigheden en visie ontwikkeling-werken in docent ontwerpteams, deze zijn multidisciplinair-21st century skills voor leerlingen maar ook de eigen vaardigheden-systematisch ontwerpen aan de hand van ADDIE fasen en TPACK-Authentieke opdrachten-vragen/uitdagingen van opdrachtgevers-samenwerking met studenten van hbo ict-

"Studenten kunnen een meerwaarde leveren op hun (toekomstige) school door (digitale) leermiddelen op waarde te kunnen schatten en gericht kunnen inzetten in onderwijssituaties". Het doel van deze minor komt voort uit de toenemende vraag binnen het onderwijs, om docenten en scholen in de 'stand' te zetten om ICT te integreren in de dagelijkse onderwijspraktijk. Er 'borrelt' vaak heel veel bij docenten, ze willen wel iets met ICT, maar het komt vaak niet van de grond. Om docenten op grote schaal mee te krijgen is inspiratie van groot belang, dit kan bereikt worden door kennis te delen. Uiteindelijk moet het uit de docent zelf komen. Deze minor draagt bij aan het opleiden van toekomstige docenten met een duidelijke visie op het gebruik van ICT in de klas. Docenten die ICT (didactisch) verantwoord kunnen integreren en anderen kunnen inspireren en activeren.
Behalve voor docenten zijn er namelijk ook andere organisaties waar leren een belangrijke rol speelt. Om dit leren optimaal te faciliteren moet er educatief materiaal worden ontwikkeld van goede kwaliteit.

Rooster minor Learning and ICT 2017-2018

Overview

college	week	Pilot- P roject *	Research	Reflection	Remaining...
1	Mon 29 Jan	Analysis		Vision	
2	Mon 5 Feb.	Analysis	Research question		IPON - fair
3	Mon 12 Feb.	Design	Plan of action	Brainstorm	
4	Mon 19 Feb.	Design	Research plan		Consult
X	Mon 26 Feb.	-			
5	Mon 5 Mar.	Development	Theory	Cycle 1	Exam
6	Mon 12 Mar.	Implementation	Theory practice	Moment 1	Consult
7	Mon Mar 19	Evaluation			Presentations
T1	Mon 26 Mar.	Evaluation →			
T2	Mon 2 Apr	→ Analysis (2)	Method		
8	Mon 9 apr	Analysis		Moment 2	Consult
9	Mon 16 apr	Design			
10	Mon 23 Apr	Development	Instruments	Cycle 2	Consult
X	Mon 30 apr	-			
11	Mon 7 May	Implementation	Collecting data	Moment 3	Do free -Helping
12	Ma May 14	Implementation			Consult
13	Mon 21 May	Evaluation	Reporting		Mon free -Pinking
14	Mon, May 28	Evaluation		Moment 4	Presentations
T1	Mon, June 4	Evaluation →	Conclusion		Consult
T2	Ma June 11	→ Analysis (3)		Outflow profile	

* we go through the ADDIE phases twice.

At the end of each week is what you have to study in any case for the next week.

Important ingredients within this minor: -focused on sustainable skills and vision development-working in teacher design teams, these are multidisciplinary-21st century skills for students but also the own skills-systematic design by means of ADDIE phases and TPACK-Authentic assignments-questions / challenges of clients-cooperation with students of hbo ICT.
"Students can provide added value to their (future) school by being able to estimate the value of (digital) learning materials and to be able to use them in educational situations". The purpose of this minor stems from the increasing demand within education, to put teachers and schools in the 'position' in order to integrate ICT into daily educational practice. Teachers often 'drink' a lot, they want something with IT, but it often doesn't get off the ground. To get teachers on a large scale inspiration is very important, this can be achieved by sharing knowledge. Ultimately it must come from the teacher. This minor contributes to the education of future teachers with a clear vision on the use of ICT in the classroom.
In addition to teachers there are other organizations where learning plays an important role. To optimally facilitate this learning, good-quality educational material must be developed.

1.3B. THE NETHERLANDS CASE STUDY: DESIGN TASK

Design task 1

Tentamen Minor Leren & ICT 1

We are currently preparing students for jobs that don't yet exist . . . using technologies that haven't yet been invented . . . in order to solve problems we don't even know are problems yet.
—Richard Riley, Secretary of Education under Clinton

Succes!

Binnen dit tentamen wordt gevraagd om e.e.a. te onderbouwen met de literatuur. Bij de beoordeling letten we op de integratie en de kwaliteit van deze onderbouwing. Verwijs middels de APA standaard naar de literatuur. Dus o.a. op de volgende wijze: (Trilling & Fadel, 2009, pp. 102), let op het vermelden van het paginanummer!

Tentamen

Het tentamen staat open vanaf 5 maart en sluit op 12 maart 23.59. Dat wil zeggen dat de uitwerking voor dit tijdstip op de elo moet zijn ingeleverd.
De tentamenstof is in het onderstaande schema weergegeven. Deze tentamenstof dien je te verwerken in het tentamen (bij de opdrachtomschrijvingen in het tentamen wordt aangegeven wanneer je een van de bronnen expliciet moet gebruiken. Uiteraard kun je zelf bepalen welke overige bronnen je gaat gebruiken om je te ondersteunen bij dit tentamen.

Tentamenstof
Zie leerstof per week
+
C21 skills: Trilling, B. & Fadel, C. (2009). *21st century skills, learning for life in our times.* San

Fransico: Jossey-Bass.

Vier in Balans: https://www.kennisnet.nl/fileadmin/kennisnet/publicatie/vierinbalans/Vier-in-balans-monitor-2017-Kennisnet.pdf

Meaningful learning with technology: https://sites.google.com/site/technologythenewworld/guia-didactica

Omschrijving tentamenopdracht
Beschrijf zelf een 'good practice' waarbij ict een duidelijke didactische meerwaarde levert aan het leerproces binnen jouw ontworpen leerarrangement. Deze 'good practice' moet authentiek zijn (zelf ontworpen).
Om de meerwaarde duidelijk naar voren te laten komen kies je een thema of onderwerp (binnen je eigen vakgebied) en werk je een '**leerarrangement**' uit welke ongeveer 2 lessen in beslag neemt (let op: dit is een richtlijn, met name omdat de omvang anders te groot wordt, je mag hiervan afwijken).

□ O**nderdeel 1: beschrijving leerarrangement**

Deze beschrijving van het leerarrangement moet voldoen aan een aantal voorwaarden:

a. Stel voor je leerarrangement heldere lesdoelen vast (SMART), dus wat moeten de leerlingen beheersen (zie figuur 1 voor de taxonomie van Bloom om de leerdoelen te koppelen aan een bepaald leerniveau, zie figuur 2 voor werkwoorden bij elk leerniveau = inspiratie voor het formuleren van leerdoelen).

b. Je stelt een helder resultaat vast waaraan je kunt 'toetsen' of de leerlingen de vooraf gestelde doelen hebben behaald. Dus hoe maak je het leren zichtbaar?

c. Je geeft aan op welke C21 skills een beroep wordt gedaan, daarbij geef je aan wat de beginsituatie van leerlingen is en hoe je deze vaardigheden traint bij leerlingen binnen het leerarrangement. Laat dit ook zien binnen je leerdoelen (onderdeel 1a). Noem drie verschillende redenen om te werken aan deze C21 skills. Onderbouw elke reden met behulp van de literatuur.

d. Je gebruikt TPACK bij het ontwerp, waarbij je de onderlinge domeinen van TPACK beschrijft (T), (P) en (C) als ook de samenhang tussen de onderdelen, dus TPACK. Beschrijf de (didactische) meerwaarde van de **T** – component bij deze leeractiviteit (of terwijl licht toe waarom het Meaningful Learning is with technology en benoem voordelen die er zijn ten opzichte van analoge leermiddelen)

e. Je geeft aan welke kenmerken uit het model van meaningful learning zijn geïntegreerd in dit leerarrangement. Geef van twee kenmerken aan waarom deze van waarde zijn in jouw leerarrangement. Onderbouw elke reden met te minste 1 (wetenschappelijke) bron.

f. Je geeft aan hoe de technologie een rol speelt in het leerarrangement aan de hand van het SAMR-model.

□ **Onderdeel 2: Docenteninstructie**

Een compacte docenteninstructie waarmee een collega het zou kunnen uitvoeren (beschrijving van de benodigde materialen en werkwijze)

□ **Onderdeel 3: Analyse kwaliteit leerarrangement (ontwerp)**

Een verantwoording waarbij je aan de hand van een SWOT-analyse de kwaliteit van je leerarrangement beschrijft. Tip gebruik de tabel (figuur 3) en licht deze kort toe. Maak gebruik van literatuur om e.e.a. te onderbouwen.

□ **Onderdeel 4: Literatuurlijst**

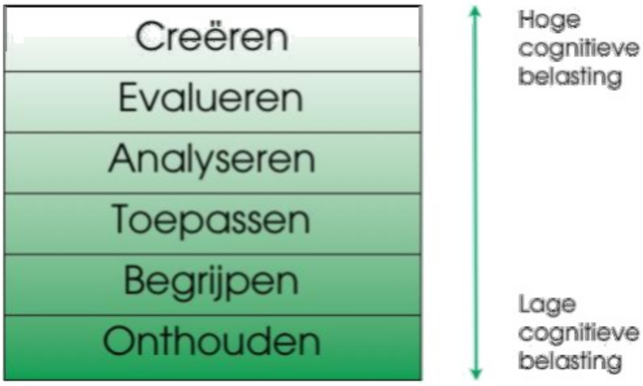
Neem een literatuurlijst op waarin de gebruikte bronnen staan (APA).

TABLE 5-5
Observable verbs for the cognitive domain

1. Knowledge		2. Comprehension		3. Application	
Recall information		Interpret information in one's own words		Use knowledge or generalization in a new situation	
arrange	name	classify	report	apply	operate
define	order	describe	restate	choose	practice
duplicate	recall	discuss	review	demonstrate	prepare
label	relate	explain	select	dramatize	schedule
list	repeat	express	sort	employ	sketch
match	reproduce	identify	tell	illustrate	solve
memorize		indicate	translate	interpret	use
		locate			
4. Analysis		**5. Synthesis**		**6. Evaluation**	
Break down knowledge into parts and show relationships among parts		Bring together parts of knowledge to form a whole and build relationships for new situations		Make judgments on basis of given criteria	
analyze	differentiate	arrange	manage	appraise	evaluate
appraise	discriminate	assemble	organize	argue	judge
calculate	distinguish	collect	plan	assess	predict
categorize	examine	compose	prepare	attack	rate
compare	experiment	construct	propose	choose	score
contrast	inventory	create	set up	compare	select
criticize	question	design	synthesize	defend	support
diagram	test	formulate	write	estimate	value

Note: Depending on the meaning for use, some verbs may apply to more than one level.

Figuur 1. Taxonomie van Bloom



Figuur 2. werkwoorden van geformuleerde leerdoelen

Strengths Waar ben ik goed in?	**Weaknesses** Wat zijn mijn minder sterke eigenschappen?
Opportunities Welke kansen zie ik voor mijzelf?	**Threats** Welke bedreigingen zijn er voor mij?

Figuur 3. SWOT-analyse

Design task 2 – instructions (differentiated in groups)

Opdrachtgever: [redacted]
Schooltype: PO
Begeleider: [redacted]
Kaders voor mogelijke opdracht
In zeer veel apparaten zit software. Denk bijvoorbeeld aan de afwasmachine, auto's en cv's. Wij computers zo goed mogelijk kunnen inzetten. Als dat lukt, zullen een betere kans in de maatschappij hebben.
Onze school heeft twee jaar op een rij meegedaan met First lego League http://firstlegoleague.nl/meedoen (en genoeg filmpjes op youtube te zien).
Dit is een wedstrijd die wereldwijd plaatsvindt, waarbij kinderen zelf een legorobot, bouwen en programmeren. Vraag: ontwerp een lesprogramma (10 lessen?) waarmee kinderen vanaf groep 5 (!) zelfstanding een basis leggen waardoor ze sneller kunnen opstarten als ze aap een wedstrijd mee gaan doen. Denk aan simpele robot bouwen, rechtdoor rijden, bocht meken en eerste gebruik sensoren.
Onze visie is dat kinderen in de onderbouw (t/m groep 4) in aanranking moeten komen met nieuwe technologie, maar op zo'n manier dat het de huidige lesdoelen ondersteunt. Op dit momenten is er 1 Bluebot in gebruik. In grope 5 (gaat ook door in 6) leren ze concepten van programmeren. Vraag: welke technologie kunnen we gebruiken in de onderbouw, zodat deze aansluit bij lesdoelen en aansluit bij andere schooljaren.
Schrijf een beleidsplan (kort) computational thinking, welke aansluit op de 21st century skills van het basisonderwijs en de route/visie van de leerlijn door de schooljaren heen tot uiting komt. Bekijk het vooral praktisch (wat heeft het kind er werkelijk aan).

Opdrachtgever: [redacted]
Schooltype: VO
Begeleider: [redacted]
Kaders voor mogelijke opdracht
Probleemsituatie
We zijn op dit moment al behoorlijk met het laptoponderwijs. Er is de afgelopen jaren een pilot gedraaid en vanaf dit schooljaar is dit onderwijs vanaf klas 1 ingevoerd. Het zal per leerjaar gefaseerd ingevoerd worden. Volgend schooljaar zullen de eerste groepen in klas 3 d.m.v. een pilot beginnen.
Er bestaat op dit momenten geen doorlopende leerlijn op het gebied van plannen. In de onderbouw wordt er op een andere manier gewerkt dan in de bovenbouw. We zouden graag zien dat hier el een doorlopende lijn in komt.
Doelen
Wij werken binnen het project aan de volgende doelen:

- Een leerling leert actief en zelfstanding te werken
- Een leerling leert verantwoordelijkheid te nemen voor zijn eigen leerproces (eigenaarschap)
- Er komt een doorlopende leerlijn op het gebied van (digitaal) plannen voor de onder – en bovenbouw
- Alle docenten (onder – en bovenbouw) hanteren dezelfde werkwijze op het gabied van (digitaal) plannen

Randvoorwaarden
Wij stellen de volgende randvoorwaarden:
- De laptop moet worden ingezet als hulpmiddel bij het (digitaal) plannen. Elke leerling beschikt in het schooljaar 2019/2020 over een laptop.
- Leerlingen moeten ten alle tijden toegang hebben tot het (digitale) systeem waaring zij eventueel gaan plannen
- Het te ontwikkelen eindproduct moet makkelijk te bedienen zij door docenten

Gewenste eindresultaat
In de eerste fase van dit project verwachten we een onderzoek naar de wijze van plannen in de onderbouw en de bovenbouw. Hieruit volgt een analyse, die aangeeft waar en how de doorlopende leerlijn wordt doorbroken. Tevens zullen er adviezen worden geformuleerd hoe we tot een “doorgaande leerlijn plannen” kunnen komen binnen onze school.
Voring jaar zijn minorestudenten mee aan de slag gegaan, in overleg met de school wordt hier een vervolg aangegeven. De school wil graag verdere stappen zetten in de richting van gepersonaliseerd leeren.

Opdrachtgever: [redacted]
Schooltype: VO
Begeleider: [redacted]
Kaders voor mogelijke opdracht Na het eerste contact met deze school kregen we de vraag: zijn er op Windesheim ook studenten die zich bezig houden met ict/virtual reality en technologie in bredere zin en daar lesprojecten voor maken (eventueel kunnen begeleiden)?
Op school is men aan de slag gegaan met verbetering van het onderwijs en sinds dit schooljaar stann er een aantal innovatiemidaggen in het jaarrooster om hiermee aan de slag te gaan.
Verschillende docenten en vakgroepen zijn bezig met het ontwikkelen van lessen en projecten. Het niveau en de intensitiet waarmee dit wordt gedaan verschilt binnen de school.
Onderwerpen waar men mee bezig is en waar jullie en bijdrage aan kunnen leveren zij onder andere:
- Digital toetsen
- Verrijken van onderwijs naast de bestande methode(s)
- Implementeren van didactische werkvormen met behulp van technologie
- ...

In maart en juni staan innovatiemiddagen op de planning, waarbij de bijeenkomst van maart bijvoorbeeld gebruikt kan worden om eerste ideeen breder te delen en de bijeenkomst in juni om het eindresultaat te presenteren.

Opdrachtgever: [redacted]
Schooltype: hbo
Begeleider: [redacted]
Kaders voor mogelijke opdracht
Gedurende de lerarenopleiding ben je op verschillende momenten bezig met het ontwikkelen van je onderzoekende houding en de vaardigheden die je nodig hebt om de praktijk van het lesgeven te onderzoeken.

Soms krijg je deze onderzoekende vaardigheden aangeboden in een apart vak "onderzoek"; soms werk je aan de onderzoekende vaardigheden bij andere vakken (bijvoorbeeld bij een module waarin je wordt gevraagd te gaan observeren in de klas).
Om je ontwikkeling op het gebied van de onderzoeksvaardigheden verder te ondersteunen, willen we als onderzoeksdocenten en – begeleiders digitaal materiaal ontwikkelen dat past bij de verschillende vaardigheden. Je kunt hierbij denken aan kennisclips over een bepaald onderdeel, verwerkingsopdrachten of een (digitale) werkwijze voor het gezamenlijk schrijven en "feedbacken" van een theoretisch kader. De (digitale) materialen kunnen zowel ingezet worden voor zelfstudie als onderdeel uitmaken van een blended les (-senreeks).

Exam ICT and Learning - Minor

We are currently preparing students for jobs that don't yet exist . . . using technologies that haven't yet been invented . . . in order to solve problems we don't even know are problems yet.
—Richard Riley, Secretary of Education under Clinton

Good luck!

Within this exam you will be asked to substantiate with the literature. In the assessment we pay attention to the integration and the quality of this substantiation. Refer to the literature through the APA standard. So in the following way: (Trilling & Fadel, 2009, pp. 102), please note the page number!

Exam

The exam is open from 5 March and closes 23.59 on 12 March. This means that the elaboration must have been submitted to the elo before this time.
The exam material is shown in the diagram below. You must process this exam material in the exam (the assignment descriptions in the exam will indicate when you must explicitly use one of the sources.) Naturally, you can decide for yourself which other sources you will use to support you in this exam.

Exam material
see course material per week
+
C21 skills: Trilling, B. & Fadel, C. (2009). *21st century skills, learning for life in our times.* San

Fransico: Jossey-Bass.

Vier in Balans: https://www.kennisnet.nl/fileadmin/kennisnet/publicatie/vierinbalans/Vier-in-balans-monitor-2017-Kennisnet.pdf

Meaningful learning with technology: https://sites.google.com/site/technologythenewworld/guia-didactica

Description of the exam assignment

Describe yourself a good practice where ICT provides a clear didactic worth of learning within your learning unit. This 'good practice ' must be authentic (self-designed).
To show the added value clearly you choose a theme or subject (within your own field) and you work out a 'learning unit ' which takes about 2 lessons (note: this is a guideline, especially because the size otherwise you will be too big, you may deviate from this).

- Part 1: Description of the learning unit

This description of the learning unit must meet a number of conditions:

a. Set clear lesson objectives for your learning unit (SMART), so what should the pupils master (see figure 1 for the taxonomy of Bloom to link the learning objectives to a certain learning level, see figure 2 for verbs at each learning level = inspiration for formulating learning goals).
b. You establish a clear result to which you can 'test ' whether the students have achieved the predetermined goals. So how do you make learning visible?
c. You indicate which C21 skills are being appealed, indicating what the initial situation of students is and how you train these skills among students within the learning unit. Show this also within your learning objectives (part 1a). Name three different reasons to work on these C21 skills. Substantiate each reason with the help of the literature.

d. You use TPACK in the design, where you describe the mutual domains of TPACK (T), (P) and (C) as well as the connection between the parts, so TPACK. Describe the (didactic) added value of the T -component in this learning activity (or while explaining why it is Meaningful Learning with technology and mention the advantages that exist with regard to analogous learning tools)
e. You indicate which characteristics from the model of meaningful learning are integrated in this learning unit. Indicate two characteristics of why these are of value in your learning unit. Substantiate every reason with at least 1 (scientific) source.
f. You indicate how the technology plays a role in the learning unit on the basis of the SAMR model.

- **Part 2: Instructional design**

A compact teacher's instructional design which could be easily performed by any colleague (description of the required materials and working method).

- **Part 3: Analysis of quality learning unit (design)**

A justification in which you describe the quality of your learning arrangement on the basis of a SWOT analysis. Tip use the table (figure 3) and briefly explain this. Use literature to substantiate your arguments.

- **Part 4: Literature references**

List your references using APA style.

TABLE 5-5
Observable verbs for the cognitive domain

1. Knowledge		2. Comprehension		3. Application	
Recall information		Interpret information in one's own words		Use knowledge or generalization in a new situation	
arrange define duplicate label list match memorize	name order recall relate repeat reproduce	classify describe discuss explain express identify indicate locate	report restate review select sort tell translate	apply choose demonstrate dramatize employ illustrate interpret	operate practice prepare schedule sketch solve use
4. Analysis		**5. Synthesis**		**6. Evaluation**	
Break down knowledge into parts and show relationships among parts		Bring together parts of knowledge to form a whole and build relationships for new situations		Make judgments on basis of given criteria	
analyze appraise calculate categorize compare contrast criticize diagram	differentiate discriminate distinguish examine experiment inventory question test	arrange assemble collect compose construct create design formulate	manage organize plan prepare propose set up synthesize write	appraise argue assess attack choose compare defend estimate	evaluate judge predict rate score select support value

Note: Depending on the meaning for use, some verbs may apply to more than one level.

Figure 1. Bloom's taxonomy

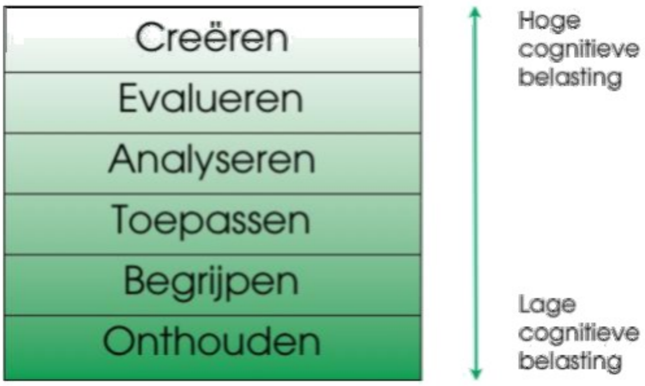


Figure 2. Verbs to formulate learning objectives.

Strengths Waar ben ik goed in?	**Weaknesses** Wat zijn mijn minder sterke eigenschappen?
Opportunities Welke kansen zie ik voor mijzelf?	**Threats** Welke bedreigingen zijn er voor mij?

Figure 3: SWOT analysis

Design task 2 – instructions (differentiated in groups)

Client: [redacted]
School type: PO
Supervisor: [redacted]
Frames for possible assignment
In very many devices there is (a) software (component). Think, for example, of the washing machine, of cars and CVs. We can use computers as well as possible. If successful, we will have a better chance in society.
Our school has participated, two years in a row now, in First Lego League http://firstlegoleague.nl/meedoen (plenty of films to see on Youtube).
This is a competition that takes place worldwide, where children build and program a Lego robot themselves. Question: design a unit (10 lessons?) that allows children from group 5 (!) to lay a foundation on their own, so that they can start up faster if they join the competition. Think to build a simple robot, (to) drive straight, make a turn and (have) first use sensors.
Our idea is that children in the lower classes (up to and including group 4) need to get in touch with new technology, but in such a way that it supports the current teaching objectives. At this time there is 1 Bluebot in use. In group 5 (also goes through in 6) they learn the concepts of programming. Question: which technology can we use in the early years, so that it fits with lesson objectives and fits in with other school years?
Write a policy plan (short) of computational thinking, which corresponds to the 21st century skills of primary education and reflects the path/vision of learning line through the school years. View it mainly practically (what do the child actually have to do).

Client: [redacted]
School type: VO
Supervisor: [redacted]
Frames for possible assignment
Problem situation

We are already good with the laptop education right now. A pilot has been run in recent years and from this school year onward, this (technological) education has been introduced from class 1. It will be declined per school year. Next school year the first group in class 3 will start a pilot.
There is currently no continuous learning path in mind. In the higher grades work is done in a different way than in the lower grades. We would like to see that there is a continuous line.

Goals

We work within the project on the following goals:

- A pupil learns to work actively and independently
- A pupil learns to take responsibility for his own learning process (ownership)
- There will be a continuous learning line in the field of (digital) plans for the lower and upper levels
- All teachers (early/higher years) can use the same method on the labyrinth of (digital) plans

Conditions

We set the following preconditions:

- The laptop must be used as an aid in (digital) planning. Each pupil has a laptop in the 2019/2020 school year.
- Pupils must at all times have access to the (digital) system where they may plan
- The final product to be developed must be easy to operate by teachers

Desired final result

In the first phase of this project, we expect an investigation into the method of planning in the early years and the higher years. An analysis follows from this, indicating where and how the continuous learning path is broken. We will also formulate advice on how we can arrive at a "continuous learning path" within our school
Every year, a minority of students have started working on this, in consultation with the school, and a follow-up is indicated here. The school would like to take further steps in the direction of personalized learning.

Client: [redacted]
School type: VO
Supervisor: [redacted]

Frames for possible assignment

After the first contact with this school, we got this question: are there students at Windesheim who are involved in ICT/virtual reality and technology in a broader sense and make lesson projects for this?
At school they started to improve education and since this school year, there are a number of innovation projects in the annual timetable to get started.
Various teachers and departments are busy developing lessons and projects. The level and intensity by which this is done differs within the school.
Topics that you are working on and what you can contribute to, include:

- Digital keys
- Enrich education next to the existing method(s)
- Implementing didactic methods with the help of technology
- …

Innovation afternoons are planned in March and June, where the meeting of March, for example, can be used to share first ideas more broadly and the meeting in June to present final results.

Client: [redacted]
School type: HBO
Supervisor: [redacted]
Frames for possible assignment

During teacher training you are busy at different times developing your investigative attitude and the skills you need to explore the practice of teaching. Sometimes you are offered these investigative skills in a separate course "research"; sometimes you work on the research skills in other subjects (for example, a module in which you are asked to observe the classroom).

In order to further support your development in the field of research skills, we, as research teachers and supervisors, want to develop digital material that fits the different skills. You can think of knowledge clips about a certain component, processing assignments or a (digital) working method for joint writing and "give feedback" on a theoretical framework. The (digital) materials can be used both for self-study and as part of a blended lesson (or series).

1.3C. THE NETHERLANDS CASE STUDY: DESIGN RUBRIC

Tabel ontwerpfase ADDIE:

Vul de onderstaande kolommen in. Zodra u alles heeft ingevuld en dus ook feedback heeft ontvangen van betrokkenen, past u uw voorlopig beeld aan.

	Voorlopig beeld van het te ontwikkelen product	Wie heb ik hiervoor nodig? Wie zijn hierbij betrokken of wie beslissen hierover	Welke activiteiten ga ik dus ondernemen? Kan dat? Met wie ga ik spreken? Wanneer? Wat wil ik daarmee bereiken? Kan ik dit? Denken anderen dat ik dit kan?
Basisvisie - Waartoe leren leerlingen? - Vanuit welke idealen of visie wil je deze module/lessen opzetten?			
Leerdoelen - Wat kunnen de leerlingen straks wat ze nu niet nog niet (voldoende) kunnen? - Wat wil je precies met je nieuwe lessenserie bereiken? - Wat kan er aan het eind van de lessenserie getoetst worden?			
Leerinhouden - Wat leren leerlingen dan? - Gaat het om vakinhouden, om vakvaardigheden of anderszins?			
Leeractiviteiten - Wat doen leerlingen? - Welk gedrag of welke activiteiten laten zij zien?			
Docentrollen - Wat betekent het voor jouw rol als docent? en evt. anderen (bijv. toa's, mentoren)			
Leerbronnen en leermiddelen - Welke middelen heb je nodig? - Digitaal, papier?			

Groeperingsvorm - Leren leerlingen in groepjes? - Hoe groot is de groep? - Samenstelling? - Wie formeert de groep?			
Tijd - Hoeveel tijd beslaat de module? - Wat betekent dit voor de inroostering en de planning?			
Leeromgeving - Waar leren de leerlingen? - Wat voor soort lokaal? - Binnen of buiten de school?			
Beoordeling - Hoe wordt getoetst wat leerlingen hebben geleerd? (Bv. schriftelijk, mondeling, door een onderzoeksopdracht, een practicumtoets?)			

Table design phase ADDIE

Fill in the columns below. Once you have filled in everything and have received feedback from those involved, you can adjust your temporary image.

	Preliminary idea of the outcome	Who do I need for this? Who are involved/decide on this?	Which activities will I therefore undertake? Is that possible? Who am I going to speak with? When? What do I want to achieve? Can I do this? Do others think I can do this?
Basic vision - What do students learn? - From which ideals or vision do you want to set up this module/lesson?			
learning goals - What will the students be able to do, that they cannot do yet? - What exactly do you want to achieve in your new lesson series? - What can be tested at the end of the lesson series?			
lesson content - What do students learn then? - Is it about subject content, professional skills or otherwise?			
learning activities - What do students do? - What behaviour or what activities do they show?			
teacher role - What does it mean for your role as a teacher? And possibly others (e.g. toa's, mentors…)			
learning sources and teaching materials - What resources do you need? - Digital, paper?			
grouping forms - Do students learn in groups?			

- How big is the group? - Composition? - Who forms the group? -			
time - How much time does the module cover? - What does this mean for the scheduling and the planning?			
learning environment - Where do students learn? - what kind of local? - Inside or outside the school?			
assessment - How is it tested what students have learned? (e.g. in writing, orally, through a research assignment, a practical test?)			

APPENDIX 2. INTERVIEWS

2.1 INTERVIEW PROMPTS

Note: what follows is the general protocol for the focused interviews. Minor modifications in the lexicon could have been inserted in the three contexts, according to the contextual observation carried out at the time of data collection.

First round of interviews
Design procedure provided in English and native language to the interviewee.

1. **Design task elements:**

a. Did you understand the instructions for your assignment?
b. Could you understand the instructions on your own or did you need any extra help from the professor or the colleagues?
c. Do you think course materials helped you understanding how to complete the assignment?
d. Was there any difference between this procedure and others you may know, for designing a learning unit with technology?

[**The underlying research questions here are:** how is the IDP perceived/understood by the students? Is the familiarization phase still ongoing or completed? Do the student perceive/understand the IDP as a useful guide to design technology enhanced learning units?]

2. **Decisional turning points in the design procedure**

SM Comprehension

a. Which topic did you choose?
b. Which concepts do you fully understand about it, and which ones are still a bit fuzzy?
c. Why did you choose this topic, to work with technologies?
d. What do you know about how to teach this topic?
e. Would you say you need to transform the concepts to make it better understandable for your students? How so?

Enabling connections

a. Which are the main activities/ phases in which you thought to teach this topic?
b. In what order would you present the concepts? Why?
c. Would you engage students' prior knowledge on the topic? Why?
d. How could you make the students create and share knowledge? Why?
e. Did you make individuals and groups interact? Why?

f. Did you consider individual needs? How so? Why?

Teaching and learning

a. Which are the technological resources you used and where?
b. Why do you think these ICT are useful in conveying the topic you chose?
c. What is the added value you thought about, in integrating these ICT?
d. Did you use formative and summative evaluation? Why?
e. Did you think to provide feedback to the students? How? Why?

Reflection

a. How are you satisfied with your work? Why?
b. What was your greatest weakness? Why?
c. Which was the most difficult part of this assignment? Which was the easiest part?

New comprehension

a. Would you say you understand better the topic, now? How so?
b. Would you say you understand better the teaching methods and techniques, now? How so?
c. Would you say you understand better how to integrate technologies in instructional design, now? How so?

[**The underlying research questions here are:** was students' pedagogical reasoning engaged in the design task? In which aspects was it mostly activated? Is there a connection among the IDP elements and the pedagogical reasoning decisional steps? Where is it most perceived?]

Relation reasoning to IDP

a. Would you say you have to think about content related questions, in your assignment? Where?
b. Would you say you have to think about learning goals definition, in your assignment? Where?
c. Would you say you have to think about prior knowledge engagement, in your assignment? Where?
d. Would you say you have to think about learning activities, in your assignment? Where?
e. Would you say you have to think about having your students work in groups, in your assignment? Where?
f. Would you say you have to think about the added value of technology, in your assignment? Where?
g. Would you say you have to think about evaluation, in your assignment? Where?

h. Would you say you have to revise your work, its strengths and weaknesses, according to your guidelines?

3. **Technological-related beliefs (to be deepened in the final interview)**

a. Would you say you're good at technology use?
b. What would you say is the role of technologies in education?
c. How do you feel about using technologies in your lessons?
d. What do you think technologies are most useful/helpful for, in education?
e. What do you think technologies are not necessary for, in education?
f. Do you think you would use these instructions to plan your lessons, using technologies?

[**The underlying research questions** here are the same of the questionnaire: these questions want to integrate the questionnaire items].

Second round of interviews

Design procedure provided in English and native language to the interviewee.

1. **Design task elements**

a. Did you understand the instruction for the assignment?

b. Could you understand the instructions on your own or did you need any extra help from Professor or colleagues?

c. Do you think reading materials on helped you for your second assignment? How so?

d. Which was the easiest part? Which the most difficult? Why?

e. What was the major difference between this assignment and the first one, for you?

[**The underlying research questions here are:** how is the IDP perceived/understood by the students? Is the familiarization phase still ongoing or completed? Do the student perceive/understand the IDP as a useful guide to design technology enhanced learning units?]

2. **Reasoning**

a. Imagine having to plan a lesson using these instructions for tomorrow's school practical: could you walk me through your planning? What do you do?
[where do you start? What do you have to consider? Does it relate to any other step? What do you need to do to make yourself ready? Is there anything you would ask the school manager?]

***students describe how they proceed to design, step by step, referring to the instructions ***

b. Here are the steps of your instructions, could you sign how they are linked, in your opinion? ***students create a map and explain***

[**The underlying research questions here are:** was students' pedagogical reasoning engaged in the design task? In which aspects was it mostly activated? Is there a connection among the IDP elements and the pedagogical reasoning decisional steps? Where is it most perceived? Do students perceive the instructions as an interconnected whole?]

3. **Technology related dispositions**

a. After these two assignments, what do you think of technologies in education?
b. After these two assignments, how do you feel in using technologies in your lessons?
c. What do you think technologies are most useful/helpful for, in education?
d. What do you think technologies are not necessary for, in education?
e. After these two assignments, do you think you will use these instructions to plan your lessons using technologies?

2.2 Codebook

Task and Procedure

Task Completion difficulties

- □ task difficulty - no easy parts
  student reports the whole task to be difficult, in terms of guidelines understanding/completion. no easy part whatsoever is detected. It implies a sense of overwhelming difficulty in completing the task.

- □ task difficulty - unfamiliar
  student reports the main difficulty of the task being its unfamiliar characteristics (e.g. item characteristics never met before, or really differently described in other examples.

- □ task difficulty - TPACK /theory
  student expresses as main difficulty the application/use of theories in the task and/or their overall understanding (as related to the task).

- □ task difficulty - timeframe
  student reports the main difficulty in the task was to think of/specify/describe the timeframe for the learning unit, as required by guidelines.

- □ task difficulty - class/context
  student reports the main difficulty was to think of/specify/describe the context for the learning unit, as required by guidelines (e.g. class, age, pupils' characteristics).

- □ task difficulty - content/knowledge
  student reports the main difficulty of the task was to think of/specify/describe the contents/topics for the learning unit, as required by guidelines.

- □ task difficulty - learning objectives
  student expresses as main difficulty the description/identification of learning objectives (and/or skills) as required by guidelines' terms.

- □ task difficulty – interests - CY
  student expresses as main difficulty to ideate/describe how to motivate students to learning, or to ground the learning unit to pupils' interests, as required by guidelines' terms (more likely to be found in CY where explicitly asked for – "motivation").

- □ task difficulty - learning activities
  student expresses as main difficulty the description/ideation of learning activities as required by guidelines' terms.

- □ task difficulty - previous knowledge – CY
  student expresses main difficulty in the task identify/bring up pupils' previous knowledge or specific misconceptions about the topic (likely more grounded in CY, where explicitly

required – "diagnosis"). It can include difficulty in understanding the very concept's definition.

- □ task difficulty – destabilization – CY
  student expresses main difficulty in completing the task section about destabilizing pupils' previous knowledge (likely more grounded in CY, where explicitly required – "destabilization")
  It can include difficulty in understanding the very concept's definition.

- □ task difficulty - teaching approach – IT
  student expresses main difficulty in completing the task section about identify/describe teaching approach (likely more grounded in IT, where explicitly required – "teaching methodology and models"). It can include difficulty in understanding the very concept's definition.

- □ task difficulty – strategies – IT
  student expresses main difficulty in completing the task section about identify/describe teaching strategies (likely more grounded in IT, where explicitly required – "strategies"). It can include difficulty in understanding the very concept's definition.

- □ task difficulty – techniques – IT
  student expresses main difficulty in completing the task section about identify/describe teaching techniques (likely more grounded in IT, where explicitly required – "techniques"). It can include difficulty in understanding the very concept's definition.

- □ task difficulty - types of a/multimod/forms of K – IT
  student expresses main difficulty in completing the task section about identify/describe types of activities, multimodality, forms of knowledge (likely more grounded in IT, where explicitly required – "type of activities", "multimodality", "forms of knowledge"). It can include difficulty in understanding the very concept's definition.

- □ task difficulty - ICT integration
  student expresses as main difficult part in the task, the integration of technologies. It can be in general (e.g. difficulty to find any affordance in any technology that could apply to the teaching/learning context) or specific (e.g. difficulty to apply the required technology to the required guidelines items – e.g. in CY) or both.

- □ task difficulty - ICT higher - CY
  student expresses as main easy difficulty in the task, the integration of technologies. It can be in general (e.g. ease to find affordances in some technology that could apply to the teaching/learning context) or specific (e.g. ease to apply the required technology to the required guidelines items) or both.
  The student specifically reports a higher difficulty to use/integrate ICT in <u>the second assignment, compared to the first one</u>. More likely to be found in Cyprus, where they were forced to use a specific tool. Only in POST interviews.

- ◻ task difficulty - evaluation
  student expresses as main difficulty the description of evaluation actions as required by guidelines' terms.

Task completion easy

- ◻ task easy - no difficulties
  student reports the whole task to be easy, in terms of guidelines understanding. no difficulties whatsoever are mentioned. It may be associated with over-perception of self-efficacy or with irrelevance of the guidelines in completing the task.

- ◻ task easy - familiar
  student reports the main easy part of the task being its familiar characteristics (e.g. item characteristics already known).

- ◻ task easy - item given
  student reports the main easy part of the task was the given item(s). It may be associated with a performance orientation.

- ◻ task easy - TPACK/theory
  student expresses as main easy part in the task, the application/use of theories in the task and/or their overall understanding (as related to the task).

- ◻ task easy - timeframe
  student reports the main easy part of the task was to think of/specify/describe the timeframe for the learning unit, as required by guidelines.

- ◻ task easy - class / context
  student reports the main easy part of the task was to think of/specify/describe the context for the learning unit, as required by guidelines (e.g. class, age, pupils' characteristics).

- ◻ task easy - content / knowledge
  student reports the main easy part of the task was to think of/specify/describe the contents for the learning unit, as required by guidelines.

- ◻ task easy - learning objectives
  student expresses as main easy part in the task the description/identification of learning objectives (and/or skills) as required by guidelines' terms.

- ◻ task easy – interests – CY
  student expresses as main easy part the ideation/description of how to motivate students to learning, or to ground the learning unit to pupils' interests, as required by guidelines' terms (more likely to be found in CY where explicitly asked for – “motivation”).

- ◻ task easy - learning activities
  student expresses as main easy part in the task, the description/ideation of learning activities as required by guidelines' terms.

- ◻ task easy - diagnosis previous knowledge – CY
  student expresses main easy part in the task identify/bring up pupils' previous knowledge (likely more grounded in CY, where explicitly required – "diagnosis"). It can include ease in understanding the very concept's definition.

- ◻ task easy - teaching approach – IT
  student expresses main easy part in completing the task section about identify/describe teaching approach (likely more grounded in IT, where explicitly required - "teaching methodologies and models").

- ◻ task easy – techniques – IT
  student expresses main easy part in completing the task section about identify/describe teaching techniques (likely more grounded in IT, where explicitly required – "techniques"). It can include ease in understanding the very concept's definition.

- ◻ task easy - ICT integration
  student expresses as main easy part in the task, the integration of (specific) technologies. It can be in general (e.g. ease to find affordances in some technology that could apply to the teaching/learning context) or specific (e.g. ease to apply the required technology to the required guidelines items) or both.

- ◻ task easy - evaluation
  student expresses as main easy part the description of evaluation actions as required by guidelines' terms.

TASK understanding

- ◻ Understanding the task
  - task difficulty - guidelines unclear
    student expresses as main difficulty the unclear guidelines: e.g. too broad to clearly know what is expected; too vague definition of elements required etc.
    <u>When coded in NL post-interviews</u>, it also includes difficulties in complying with the external requirements (the task implied dealing with real schools in the definition of projects), sometimes beyond the students' action range.

  - task easy - guidelines clear
    student reports task being easy because of clear guidelines
    <u>When coded in NL post-interviews</u>, it also includes ease in complying with the external requirements (the task implied dealing with real schools in the definition of projects), sometimes beyond the students' action range.

- task external help used
  student reports having used external help in understanding guidelines, completing the task, or both. External help may have come from professor(s), assistant(s), fellow students, friends, literature sources etc.

- task external help needed
  student reports the need for yet further external help in understanding guidelines, completing the task, or both. External help may include professor(s), assistant(s), fellow students, friends, literature sources etc.

- task familiarity
  student report the task as being something familiar (e.g. same task as required in other courses). It does not imply ease/difficulty to complete it.

- task unfamiliarity
  student report the task as being something unfamiliar (e.g. task very different from the ones required in other courses). It does not imply ease/difficulty to complete it.

- How to perform the task
  - task difficulty - ICT fit – IT
    Student reports as main difficulty the task requirement to fit ICT into an existing lesson plan, or anyway one that could have worked fine without it. It includes the mentioning of simple juxtapositions of ICTs without effective meaning/added value, which may have been there if the design would have been ICT-integrated from the beginning. More likely to be found in the Italian context, where required.

  - task easy - ICT fit – IT
    Student reports as main easy part the task requirement to fit ICT into an existing lesson plan, or anyway one that could have worked without it. It includes the mentioning of fear of a blank page, ease in revising existing plans with a new perspective, finding effective meaning/added value in ICTs. More likely to be found in the Italian context, where required. Only in POST interviews.

  - task difficulty - group/single session
    student expresses as main difficulty in the task, the group /individual work required to complete it.

  - task easy - group/single
    student expresses as easy part of the task, the group /individual work required to complete it.

- task irrelevance
  student reports the guidelines as being irrelevant in the completion of the task (e.g. designed the learning unit in their own way and only then complied with the assignment's requirements).

- task performance oriented
  student expresses strong performance orientation: task ease of use, characteristics and sustainability are viewed in terms of exam grade. No personal reflection on the task in itself.

Task perceived value

- task use NO
  Student reports a refusal/lack of willingness/worth in using given guidelines (overall). Reasons can be related to: overall guidelines' clearness; help in structuring planning thoughts; help identify crucial design parts; organized/meaningful/logic internal structure; effort/time - product rate.

- task use partial
  Student reports willingness in using /worth of use of part of given guidelines. Reasons may be e.g. flexibility to context; need to have enough time; use as final check; use as potential benchmark only when in doubt/difficulty.

- task use YES
  Student reports willingness in using /worth of use of given guidelines (overall). Reasons can be: overall guidelines' clearness; help in structuring planning thoughts; help identify crucial design parts; well organized/meaningful/logic internal structure; effort/time - product rate.

- task use YES ICT
  Student reports willingness in using /worth of use of given guidelines (overall), linking the reason to integrating technologies in lesson planning.

- task use ICT openness
  student comments that by performing the design cycle(s) he/she is now more open to use ICT in his/her lessons. It implies just a general openness (if reasoned, coded under "disp. ICT reasoned openness"). It is linked to the specific task, may be specific tool used (see CY and the ICT requirement). The student explicitly reports a change in the reasons/degree of openness/willingness to use ICT, especially in education. If the change is in a negative direction (e.g. less reasons to use it, higher avoidance and lower willingness) this will be coded as "Disp. ICT no worth" without further comment. Only higher willingness, more critical/aware but personal/reasoned comments on the ICT use in education (when compared to the previous ones) are in this code.
  It can imply an improvement in comparison to previous scepticism.

DISPOSITIONS TOWARDS TECHNOLOGY INTEGRATION

- Openness to change and anxiety
  - Emotive barriers
    - disp. ICT anxiety
      student reports anxiety in/fear of/stress in using ICT. It can extend to educational environment.

    - disp. ICT avoidance
      student reports difficulty of use of ICT, avoidance to use it often. It includes "I'm not a technology person".

  - Emotive enablers
    - disp. ICT cautious
      student reports slight likelihood/willingness/openness to use ICT, even in education. It might be driven by external pressure (e.g. I know it's important in education, so I have to improve). The overall comment is sceptical though, or restricted by other resistance (also just referred to exposure to specific tools). The reasons given are in terms of pressure, equipment or any limitation to ICT integration.

    - disp. ICT ease
      student reports ease of use of ICT, likelihood to use it often, enjoyment in doing so. It can extend to educational environment.

    - disp. ICT openness
      student reports likelihood/willingness/openness to use ICT, even in education. It might be driven by external pressure (e.g. I know it's important in education, so I have to improve). General expression of openness to ICT integration in education.

    - disp. ICT reasoned openness
      student reports likelihood/willingness/openness to use ICT, even in education.
      It includes an openness to use technologies that is reasoned upon, e.g. with mention of specific topics/affordances/students' characteristics etc. .
      It includes actual reasons to be open, not just a general disposition to use ICT in a possible future. The reasons given are in terms of value, potentialities or any specific possible use for ICT integration.

  - Worth of ICT
    - disp. ICT no worth
      student reports reasoned avoidance to use ICT in educational environment. it includes reasons of infrastructure of schools, time-effort rate, educational worth.
      It can be referred to any technology or just a specific one.

- disp. ICT irrelevance
  student comments on the worth of ICT integration as being irrelevant (e.g. the learning experience is the same with or without technologies). It can be referred to any technology or just to a specific one.

- disp. ICT no limit
  student comments on the fact that ICT (in education also) might have no limit. It could eventually overcome teacher role. It doesn't need to imply anxiety about it.

- Limits of ICT
  - disp. ICT no health
    student comments on the main limit of ICT integration in education: it is linked with health conditions (e.g. problems with safety, sight, hearing, moving etc.).

  - disp. ICT no social
    student comments on the main limit of ICT integration in education: it is the loss of human contact, emotional support, social skills etc., deemed as important in the teaching-learning dynamic.

  - disp. ICT no indiv. Needs
    student comments on the fact that ICT (in education also) cannot include different educational needs (e.g. also special needs) or cannot help all the students participate to the learning process.

- Pedagogical beliefs
  - Learning definitions
    - disp. learning. Work
      student reports as main factor for learning the fact that it is oriented to enable the pupil to enter/advance in the labour market.

    - disp. learning. fun
      student reports as main factor for learning the fun experienced in/offered by the activities/tools. It includes any reference to the need of avoid boredom as crucial point in teaching actions.
      It MAY be used as reason why NOT to use ICT in education (i.e. as their limit).

    - disp. learning. feeling
      student reports as main factor for learning the acknowledge and action on feelings involved (e.g. my students need to feel at ease, need to be motivated all the time).
      It MAY be used as reason why NOT to use ICT in education (i.e. as their limit).

- disp. learning. active
  student reports as main factor for learning the fact pupils should be actively engaged in building new knowledge.
  It MAY be used as reason why NOT to use ICT in education (i.e. as their limit).

- disp. learning. manual
  student reports as main factor for learning the fact pupils should be using their hands and manipulating objects more than anything else
  It MAY be used as reason why NOT to use ICT in education (i.e. as their limit).

- disp. learning. meaningful
  student reports as main factor for learning the fact that it is meaningful to the pupils, e.g. related to their experiences/needs/previous knowledge, long term life goals. It can imply students growing to be critical, autonomous, responsible in their learning, and an attention for different media/modalities to get to this goal at best.

- Learning theories
  - disp. learning theory. instruct
    student reports on teaching methodologies/approaches or learning features typical of instructivism theory (e.g. the teacher possesses all the knowledge to transmit to the students; learners thought as blank slates - no need to check for previous knowledge; teacher relies only on him/herself, not on external tools like ICT; teacher knows best; teacher controls everything). It can imply an idea of education as training to the labour force world.

  - disp. learning theory. behav
    student reports on teaching methodologies/approaches or learning features typical of behaviourism theory (e.g. SRR, self-evident performance assessment, programmed instruction, drill-and-practice interactions, classroom management tools to record, reward and share on students' behaviour).

  - disp. learning theory. cogn
    student reports on teaching methodologies/approaches or learning features typical of cognitivism theory (e.g. learning is information encoding/retrieval/processing in memory; cognitive load; conceptual maps; advance organizers).

  - disp. learning theory. constr
    student reports on teaching methodologies/approaches or learning features typical of constructivist theory (e.g. learning gives meaning to experiences in mental/social environments; collaborative learning; cognitive apprenticeship on construction of meaning; metacognitive prompts; scaffolding; ZSP).

- disp. learning theory. conn
  student reports on teaching methodologies/approaches or learning features typical of connectivism theory (e.g. learning is connecting info among human and non-human sources; teacher as network member; collaborative/portable learning).

- Students' identity
  - disp. pupils. Knowledge/skills
    student reports on expectations/assumptions on learners' knowledge (e.g. they have these misconceptions, they are not supposed to know this, they can't understand this - all also in positive).
  - disp. pupils. digital natives
    student reports on expectations/assumptions on learners being digital natives (e.g. they are exposed to digital technologies since birth, they know how to use all of them, they use them all the time).
  - disp. pupils in charge
    student reports to want learning to be student driven (e.g. students should choose how/what to learn). It implies a vision of the teacher as peripheral, just a helper, not the main lead. It can imply giving students possible options to choose from.

- Teacher's identity
  - disp. teacher self-centred
    student reports the main value in teaching actions is for the teacher to be happy, entertained, motivated, engaged.
  - disp. teacher no responsib
    student comments on the idea of a teacher who has no true responsibility for teaching-learning dynamics (e.g. I don't have a choice for the topic, the National Curriculum does it for me ; I don't have a choice for teaching methods, the school/pupils decide for me etc.). Extremely prone to external pressure.
  - disp. pupils like me
    student reports the main thing in teaching/learning is for the teacher to be liked (in its person and didactic choices).
  - disp. teacher in control
    student reports on teaching methodologies/approaches or learning features indicating a strong control by the teacher (e.g. the teacher possesses all the knowledge to transmit to the students; learners thought as blank slates - no need to check for previous knowledge; teacher relies only on him/herself, not on external tools like ICT; teacher knows best; teacher controls everything).

- disp. teacher motivated
  student expresses high motivation in becoming a teacher and/or learning everything connected to teaching.

- disp. teacher expert
  student comments on the requirement for the teacher to be knowledgeable on the topic/methodology/ resources. Strong pressure on teacher's "strive to perfection" but no particular mention of teacher controlling each and every part of the classroom dynamic.

- disp. teacher reflective
  student comments on the idea of a teacher who reflects along the way and asks him/herself questions on teaching <u>efficacy for learning.</u>

- Teacher methodology

- disp. evaluation NO
  student expresses refusal for explicit evaluation actions (e.g. I don't believe in grades, who am I to judge students, I don't think it's necessary). It includes the refusal for feedback (e.g. I don't tell the students how they performed).

- disp. group work. NO
  student comments on group work: it is not suitable, e.g. because the teacher can't control/assess the students; students can't really learn from each other; students feel judged by the others; students can't really express/be themselves in a group.

- disp. group work. social
  student comments on group work: it is worthy to make students experience/develop social/communication skills. It doesn’t have to imply learning improvement.

- disp. group work. self-identity
  student comments on group work: it is worthy to make students grow in their identity as learners/individuals.

- disp. group work. active
  student comments on group work: it is worthy to make students active in their learning.

- disp. group work. peer tutoring
  student comments on group work: it is worthy to make students tutor each other and enhance knowledge building. It can include value linked to addressing learners’ differences (i.e. differentiation strategy). It goes from a worth in building/sharing/ new knowledge, to value for supporting/scaffolding the process, to checking and giving feedback.

- disp. individual needs.NO
  student comments on the fact that pupils are all the same/there aren't any differences among them or there's anyway no need to address individual needs with a specific teacher action.
  General judgment/comment (e.g. "I don't think it's important").

- disp. individual needs. vague
  student comments on the fact that pupils' differences in learning needs exists, e.g. referring to special needs. Student comments something must be done, by the teacher, but does not express further actions. It includes also setting up group work assuming it automatically will solve any individual needs issue by itself.

- disp. individual needs. QT
  student comments on the fact that pupils' differences in learning needs are to be addressed with a specific teacher action: more explanation/exercise (increase quantity of input without modifying it much). It also includes extra exposure to the teacher (e.g. 1:1 teaching).

- disp. individual needs. tailoring
  student comments on the fact that pupils' differences in learning needs are to be addressed with specific teacher actions: flexibility in methodologies, tailoring ways of teaching, timeframe, adapting content etc. to skills/knowledge that they already have or they show/develop during the learning process.

- Self-efficacy
  - disp. self-eff. ICT integration
    student comments on their confidence about actually integrating ICT in teaching practices.

  - disp. self-eff. Confidence in routine
    student comments on their confidence about teaching/learning aspects related mainly to their own past/external experiences and routines.

  - disp. self-eff. low
    student comments on their low confidence about teaching in terms of either understanding students' needs, identifying teaching methods, implementing them, choosing topics/tools/resources.

  - disp. self-eff. perfectionist
    student comments on their confidence about teaching in terms of being a perfectionist, never fully satisfied of their work. It can include the ones that think that their work can always improve through further experiences/learning.

- disp. self-eff. over
  student comments on their confidence about teaching in terms of being very good at it, even to the point of not needing any further improvement.

ICT AFFORDANCES

- Learning-centred
  - aff. fun
    student reports ICT affordance in making the lesson fun/attractive for the students.

  - aff. access information
    student reports ICT affordance in accessing information on the topic. It can imply simple visualization without further implications.

  - aff. engaging
    student reports ICT affordance in making the lesson engaging for the students, related to their previous knowledge/experiences, their actual interests/needs. It is usually related to learning and/or content.

  - aff. scaffolding
    student reports ICT affordance in scaffolding the learning experience.

  - aff. improve comprehension
    student reports ICT affordance in making the content clearer in terms of comprehension of the topic.

  - aff. meaningful learning
    student reports ICT affordance in making the topic/learning session meaningful to the pupils, e.g. related to their experiences/needs/previous knowledge, long term life goals.
    It can imply students growing to be critical, autonomous, responsible in their learning.
    It can imply a use of ICT to personalize/tailor the learning experience, according to specific needs.

  - aff. expression
    student reports ICT affordance in enabling students to express themselves (personally) and their learning (academically).

  - aff. active learning
    student reports ICT affordance in making students active in their learning (e.g. learn for themselves).
    It does not imply lack of responsibility from the teacher.

- aff. Cooperative learning
  student reports ICT affordance in enabling/supporting/fostering cooperative learning (also in a connectivist perspective).

- aff. Compensative spec. needs
  student reports ICT affordance in addressing specific needs of students (e.g. special needs, safety issues).

- Teaching-centred
  - aff. mobile
    student reports ICT affordance in being mobile, easy to carry.

  - aff. teacher side
    student reports ICT affordance in making the lesson easier on the teacher (e.g. time saving, material saving, organizational potentialities etc.).

  - aff. repository
    student reports ICT affordance in providing documentation of the learning unit to the service of the teacher and/or the students (e.g. as future examples).

  - aff. discipline
    student reports ICT affordance in controlling/disciplining students. It can be related to content knowledge. It can imply a behaviour-reward/punishment logic.

  - aff. drill and practice
    student reports ICT affordance in enabling/supporting/fostering drill and practice based activities.

  - aff. assessment
    student reports ICT affordance in assessing specific students' characteristics (e.g. learning goals, previous knowledge, misconceptions).

REASONING

- Core to design
  - map. core. context location/equipment –NL
    student poses at the centre of his/her map the item(s) in his/her procedure that indicate context as in equipment, location. It may not be graphically the centre, but the student states it is the main core of his/her lesson plan.
    Consider in NL there are specific items for this (location, location arrangement, learning environment).

- map. core. time
  student poses at the centre of his/her map the item(s) in his/her procedure that indicate time. It may not be graphically the centre, but the student states it is the main core of his/her lesson plan.

- map. core. context students
  student poses at the centre of his/her map the item(s) in his/her procedure that indicate class/students in their characteristics (e.g. class year/ n. of students/ specific needs/ special needs). It may not be graphically the centre, but the student states it is the main core of his/her lesson plan.

- map. core. background vision – NL
  student poses at the centre of his/her map the item(s) in his/her procedure that indicate the background approach to education (e.g. learning theory). It may not be graphically the centre, but the student states it is the main core of his/her lesson plan.
  Consider in NL there is a specific item for this (background approach).

- map. core. teaching approach – IT
  student poses at the centre of his/her map the item(s) in his/her procedure that indicate specific teaching approaches (e.g. strategies, techniques etc). It may not be graphically the centre, but the student states it is the main core of his/her lesson plan.
  Consider in IT there are specific items for this (teaching model/methodology and sub).

- map. core. subject
  student poses at the centre of his/her map the item(s) in his/her procedure that indicate subject matter (in general and/or specifics). It may not be graphically the centre, but the student states it is the main core of his/her lesson plan.

- map. core. previous k./skills – CY
  student poses at the centre of his/her map the item(s) in his/her procedure that indicate students' (previous) knowledge and skills. It may not be graphically the centre, but the student states it is the main core of his/her lesson plan
  More likely to be found in CY where they have a specific item for this.

- map. core. goals
  student poses at the centre of his/her map the item(s) in his/her procedure that indicates learning goals (cognitive, content related, skill related, ICT related/ teacher related etc.). It may not be graphically the centre, but the student states it is the main core of his/her lesson plan.

- map. core. Activities – NL
  student poses at the centre of his/her map the item(s) in his/her procedure that indicates learning activities. It may not be graphically the centre, but the student states it is the main core of his/her lesson plan.

Notice this is the lexicon used in NL for learning activities where (ideally) to build new knowledge.

- map. core. build knowledge – CY
  student poses at the centre of his/her map the item(s) in his/her procedure that indicates building new knowledge/learning. It may not be graphically the centre, but the student states it is the main core of his/her lesson plan.
  Consider this is the lexicon used in CY for learning activities section.

- map. core. ICT
  student poses at the centre of his/her map the item(s) in his/her procedure that indicate technologies. It may not be graphically the centre, but the student states it is the main core of his/her lesson plan.

- map. core. evaluation
  student poses at the centre of his/her map the item(s) in his/her procedure that indicate evaluation/assessment. It may not be graphically the centre, but the student states it is the main core of his/her lesson plan.

- map. new. Core. differentiation
  student adds item to the original procedure: differentiation.

- map. new. Core. students
  student adds item to the original procedure: students (as in "individual differences" for skills and previous knowledge/experiences).

- map. new. Core. teamwork
  student adds item to the original procedure: teamwork.

- Considered issues
  - Context
  - NTK. context outline (background approach) – NL
    Need To Know. Student reports need to know/ take into consideration the contextual characteristics, when designing a learning unit (e.g. background approach of the school to the subject/teaching approaches allowed). More likely to be found in NL where there was a specific item on this (background approach).

  - NTK. context outline (location) - NL
    Need To Know. Student reports need to know/ take into consideration the contextual characteristics, when designing a learning unit (e.g. given time and location, equipment, time).

More likely to be found in NL where there were items on this (location arrangement, location, learning environment).

- NTK. context outline (class)
  Need To Know. Student reports need to know/ take into consideration the contextual characteristics, when designing a learning unit (e.g. class year/n. of students/type of school).

- NTK. context. individual needs
  Need To Know. Student reports need to know/ take into consideration students' individual/special needs, when designing a learning unit (e.g. special needs, different knowledge/experiences).
  It could be part of the general contextual exploration, it does not imply the student is actively addressing them, yet.

- Lesson practice
  - NTK. subject broad
    Need To Know. Student reports need to know/ take into consideration the discipline/ subject to be taught, when designing a learning unit. No specific mention to particular topics/themes in it.
    It can be part of the first contextual exploration, it does not imply active action on the subject.

  - NTK. subject – SPEC - CY
    Need To Know. Student reports need to know/ take into consideration/explain the specific topic within the broad subject. Reasons could relate to national curriculum, specific children misconceptions/previous knowledge/experiences/level....
    Consider in Cyprus there is a specific item for this.

  - NTK. previous knowledge – CY
    Need To Know. Student reports need to know/ take into consideration students' previous knowledge and the lack/misconceptions thereof about the chosen topic. More likely to be found in CY, where the procedure mentioned this element (diagnosis & destabilization).
    It can include students' previous experiences.

  - NTK. goals
    Need To Know. Student reports need to know/ define/ take into consideration educational goals for the learning unit to plan. They may be content related, technology related, skill related, teacher related or other.

  - NTK. materials
    Need To Know. Student reports need to know/ identify/ prepare/ take into consideration sources/resources for the teaching practice. It can imply the acknowledgement of what

is available (e.g. equipment) and/or the active intention of gathering/creating materials/tools/instruments.

- NTK. materials ICT
  Need To Know. Student reports need to know/ identify/ prepare/ take into consideration technological sources/resources for the teaching practice. It can imply the acknowledgement of what is available (e.g. equipment) and/or the active intention of gathering/creating materials/tools/instruments. It can imply mentions of affordances and "added value"

- Teaching/lesson modalities
  - NTK. Grouping – NL
    Need To Know. Student reports need to take into consideration grouping forms within the educational practice.
    It does not imply actually deciding for it (e.g. he/she might consider it and decide it is not worthy). More likely to be found in NL where there were items on this (grouping forms).

  - NTK. multimod./forms of knowledge – IT
    Need To Know. Student reports need to know/ take into consideration different modalities of presenting a topic and/or forms of knowledge implied in the topic or emerging from the pupils.
    More likely to be found in IT (post), where the procedure mentioned this element.

  - NTK. teacher role
    Need To Know. Student reports need to know/ take into consideration the teacher role during school practices. The type of role (e.g. in control – disp. instr/ peripheral – disp. pupils in charge) is given by associated disposition.

  - NTK. teaching approach – IT
    Need To Think. Student reports need to think/take into consideration the specific teaching approach needed for the learning unit (e.g. strategies, techniques etc). It can include a concern for previous approaches used within a specific context (e.g. "I want to know how they're used to work")
    More likely to be found in Italy where they had a lot of items on this.

  - NTK. Unexpected/flexibility
    Need To Know. Student reports need to know/ take into consideration the fact that circumstances may change suddenly, and the teacher needs to adapt. Read: flexibility.
    If associated with "no responsibilities" it means the teacher is abdicating any decision in favour of the contextual emergencies.

- Enacted issues
  - Context
    - NTP. real life scenario (subject)
      Need To Plan. Student reports need to plan/ prepare a learning unit linked to students' real life competences and experiences (e.g. invite the city to a school event, organize a trip).

    - NTP. subject – teachable – CY
      Need To Plan. Student reports need actively analyse/modify the chosen topic in relation to its teachable potential, as related to the specific context/pupils.
      Consider in Cyprus there is a specific item for this (explanation of the choice).

  - Teaching/lesson practice
    - NTP. activities
      Need To Plan. Student reports need to plan/ prepare activities involving students more or less actively. It includes the activity, its time, location, materials...whenever they are described without any explicit mention of the building knowledge, but with a focus on "doing".
      No explicit mention of the activities' aim to build knowledge. It does not mean it could not be implied in the mind of the student.

    - NTP. introduction and motivation (CY)
      Need To Plan. Student reports need to plan/ prepare activities aimed at explaining/showing/sharing with pupils the overall learning unit and/or single lesson. It does not imply any action to engage actively their interests/previous knowledge/experiences/motivation on the topic.
      Student reports need to plan/ prepare activities linked to pupils' interests and aimed at motivating them to learn the chosen topic.
      Note: in The NL it is not part of the IDP, but usual in other courses/internships to start off with this. More likely to be found in CY, where the procedure mentioned this type of activity.

    - NTP. previous knowledge – CY
      Need To Plan. Student reports need to plan/ prepare activities linked to pupils' previous knowledge and aimed addressing them (and the lack/misconceptions thereof) about the chosen topic. More likely to be found in CY, where the procedure mentioned this type of activity (diagnosis & destabilization).

    - NTP. build knowledge – CY
      Need To Plan. Student reports need to plan/ prepare activities where students are actively building knowledge. Consider this was a specific item in CY (building new knowledge).

- NTP. apply/practice/revise knowledge – CY

  Need To Plan. Student reports need to plan/ prepare activities to make students practice/apply their new knowledge/skills on the chosen topic. More likely to be found in CY, where the procedure mentioned this type of activity. It can include exercises and drill practices.

  Student reports need to plan/ prepare activities to make students revise their new knowledge/skills on the chosen topic, in comparison to their original ones.

- NTP. Assessment

  Need To Plan. Student reports need to plan/ prepare activities aimed at assessing students on their content knowledge, skills or other.

- NTP. feedback

  Need To Plan. Student reports need to prepare/consider giving their pupils feedback during/at the end of the learning unit.

- Teaching modalities
  - NTP. build knowledge together

    Need To Plan. Student reports need to plan/ prepare activities where students are actively building knowledge through sharing and discussing information on the topic. It implies forms of group work.

    It implies further considerations/actions on collaborative/group work, e.g. the need to evaluate it.

  - NTP. tailoring

    Need To Plan. Student reports need to plan/ prepare activities linked to address students' needs/characteristics by adapting teaching practices (e.g. giving more time, providing different medias/sources).

- How to consider issues
  - NTK. coherence/connection

    Need To Know. student states the need to consider the underlying coherence/connection among different parts of the task/learning unit (no strict link to IDP items' connection).

  - NTP. IDP

    student links a reasoning step to a (group of) item(s) in his/her IDP.

- Reasons to discard issues
  - No - NTK. unnecessary

student claims some items are not necessary in a lesson plan, or too seldom thought of. It could be that the action/item is deem as self-explained through practice (e.g. "I don't need to think content through, because it will be clear once I teach it"). It can also be expressed as "It is so clear and obvious I don't even think about it", so unnecessary.

- No-NTK - for this lesson
  student claims some items are not necessary in the given situation (e.g. lesson planning). He/she can claim said elements are not necessary for a specific context (e.g. a group of students) or pedagogy (e.g. because at the beginning/end of a learning unit), but could possibly be used in other situations.

- No-NTK - irrelevant/implied/artificial
  Student reports no need to know/ take into consideration/explain the specific item, because already implied on others, or not significantly different (in the personal perception/understanding of it) from others. It is more related with the understanding of the task than with the worth of the action suggested by the item itself.

- No-NTK. IDP
  student cannot find any correspondence between an expressed reasoning step and any (group of) item(s) in his/her IDP. He/she might report that he/she thought of that aspect because of personal experience or external influence. It may link to "task. irrelevance", but more circumscribed to single/groups of item(s).

APPENDIX 3. QUESTIONNAIRE

3.1 QUESTIONNAIRE ITEMS' SOURCES

Sources and legend:

- **Chris. 09**

  Christensen, R., & Knezek, G. (2009). Construct validity for the teachers' attitudes toward computers questionnaire. *Journal of Computing in Teacher Education, 25*(4), 143–155.

- **DeR. 15**

  Messina, L. & De Rossi, M. (2015). Questionario sulle credenze docenti per l'integrazione delle tecnologie nella didattica [University Research Team protocol].

- **Heit. 16**

  Heitink, M., Voogt, J., Verplanken, L., van Braak, J., & Fisser, P. (2016). Teachers' professional reasoning about their pedagogical use of technology. *Computers & Education, 101*, 70-83.

- **Papa. 08**

  Papanastasiou, E. C., & Angeli, C. (2008). Evaluating the Use of ICT in Education: Psychometric Properties of the Survey of Factors Affecting Teachers Teaching with Technology (SFA-T3). *Educational Technology & Society, 11* (1), 69-86.

- **Sch.09**

  Schmidt, D., Baran, E., Thompson, A., Mishra, M., Koehler, M., & Shin, T. (2009). Technological Pedagogical Content Knowledge (TPACK): The Development and Validation of an Assessment Instrument for Preservice Teachers. *Journal of Research on Technology in Education, 42*(2), 123-149.

- **Ton. 16**

  Tondeur, J., van Braak, J., Siddiq, F., & Scherer, R. (2016). Time for a new approach to prepare future teachers for educational technology use: Its meaning and measurement. *Computers & Education, 94*, 134-150.

- **Yil. 16**

  Yilmaz-Ozden, S., Mouza, C. & Harlow Shinas, V. (2016). Teaching knowledge with curriculum-based technology: Development of a survey instrument for pre-service teachers. *Journal of Technology and Teacher Education, 24*(4), 471-499.

PART		SOURCE	ORIGINAL RELIABILITY	NOTES
Intro		Sch. 09	n.d.	
Part 1	Title	Sch.09; Papa. 08	n.d.	
	Instruction	Papa. 08	n.d.	Circle → cross
	Item 1	DeR.15 (position) Sch. 09 , Papa.08 (F;M)	n.d.	Modified for CY context (inverted gender)
	Item 2	DeR.15 (position) Sch. 09 (range)	n.d.	Modified for CY context (first range)
	Item 3	Sch. 09	n.d.	Modified for IT context (added 5th year)
	Item 4	Papa. 08	n.d.	Modified for CY context (specified university)
	Item 5	DeR.15	n.d.	Options: • In CY: Y- PP (1), Y – P (2), Y – LS (3), Y – S (4), Y – O (5), N (0) • In NL: Y- PP (1), Y – P (2), Y – LS (3), Y – S (4), Y – S voc (6), Y – O (5), N (0) • In IT: Y – PP (1), Y – P (2), Y – LS (3), Y – S (4), Y – O (5), N (0)
	Item 6	DeR.15	n.d.	Modified formulation for CY context Options: • In CY: Y – ALW (1), Y – MOST (2), Y – ONLY (3) • In NL: Y – OFT (1), Y – SMTM (3), NEVER (0) • In IT: Y – OFT (1), Y – SMTM (3), NEVER (0) Recode variable: 0= No/Never 1= Only -CY/ Sometimes – NL 2= Most – CY 3= Always – CY / Often - NL
	Item 7	Papa. 08	n.d.	

PART			CONTENT	SOURCE	ORIGINAL RELIABILITY	NOTES
Part 2: TK	Title			DeR.15		Modified by researcher
	Instruction			DeR.15; Sch.09	n.d.	Added "digital technologies"
	Description			Papa. 08; DeR. 15		Eliminated in CY version
	A	K_SFW1	Word	Papa. 08; DeR. 15	.85* α Cronbach	Examples from both Papa. Category: k. of common software applications * In DeR. 15 Examples modified in CY context
	B	K_SFW2	Excel	Papa. 08; DeR. 15	.85* α Cronbach	Examples from both Papa. Category: k. of common software applications * In DeR. 15 Examples modified in CY context
	C	K_SFW3	Paint	Papa. 08; DeR. 15	.85* α Cronbach	Examples from both Papa. Category: k. of common software applications

						* In DeR. 15 Examples modified in CY context
	D	K_SFW4	MovieMaker	DeR. 15	.85 α Cronbach	Examples modified in CY context
	E	K_SFW5	PowerPoint	Papa. 08; DeR. 15	.85* α Cronbach	Examples from both Papa. Category: k. of common software applications * In DeR. 15 Examples modified in CY context
	F	K_HDW1	IWB	DeR. 15	.85 α Cronbach	Examples modified in CY context
	G	K_INT1	Email	Papa. 08; DeR. 15	.85* α Cronbach	Examples from both Papa. Category: k. of common software applications * In DeR. 15 Examples modified in CY context
	H	K_INT2	Chrome	DeR. 15	.85 α Cronbach	Examples modified in CY context
	I	K_INT3	Google	DeR. 15	.85 α Cronbach	Examples modified in CY context
	J	K_INT4	Scholar	DeR. 15	.85 α Cronbach	Examples modified in CY context
	K	K_INT5	Forum	DeR. 15	.85 α Cronbach	Examples modified in CY context
	L	K_SFW6	Access (databases)	Papa. 08; DeR. 15	.85* α Cronbach	Examples from both Papa. Category: k. of specialized software applications * In DeR. 15 Examples modified in CY context
	M	K_SFW7	Hyperstudio (multimedia)	Papa. 08	n.d.	Papa. Category: k. of specialized software applications Examples modified in CY context
	N	K_SFW8	Kidspiration (c-map)	Papa. 08	n.d.	Papa. Category: k. of specialized software applications Examples modified in CY context
	O	K_SFW9	Publisher	Papa. 08	n.d.	Papa. Category: k. of specialized software applications Examples modified in CY context
	P	K_SFW10	Frontpage (webpage)	Papa. 08	n.d.	Papa. Category: k. of specialized software applications Examples modified in CY context
	Q	K_SFW11	Logo (programming)	Papa. 08	n.d.	Papa. Category: k. of specialized software applications Examples modified in CY context
	R	K_SFW12	Model-it (modeling)	Papa. 08	n.d.	Papa. Category: k. of specialized software applications Examples modified in CY context
	S	K_SFW13	Stagecast (simulation)	Papa. 08	n.d.	Papa. Category: k. of specialized software applications Examples modified in CY context

PART			CONTENT	SOURCE	ORIGINAL RELIABILITY	NOTES
Part 3 Freq.T	Description			(Papa. 08)		Modified by be
	A	Freq_Pers1	Fb	DeR. 15	n.d.	Examples modified in CY context

	B	Freq_Pers2	FIFA	Papa. 08	n.d.	Examples modified in CY context
	C	Freq_SFW1	Word	Papa. 08	n.d.	Examples modified in CY context Papa. Category: use of common software applications
	D	Freq_SFW2	Excel	Papa. 08	n.d.	Examples modified in CY context Papa. Category: use of common software applications
	E	Freq_SFW3	Paint	Papa. 08	n.d.	Examples modified in CY context Papa. Category: use of common software applications
	F	Freq_SFW4	MovieMaker	(DeR. 15)	n.d.	Modified by researcher Examples modified in CY context
	G	Freq_SFW5	PowerPoint	Papa. 08	n.d.	Examples modified in CY context
	H	Freq_INT1	Email	Papa. 08	n.d.	Examples modified in CY context
	I	Freq_INT6	Surf internet	Papa. 08	n.d.	Examples modified in CY context Papa. Category: use of common software applications
	J	Freq_INT4	Scholar	(DeR. 15)	n.d.	Modified by me - Examples modified in CY context
	K	Freq_INT5	Forum	(DeR. 15)	n.d.	Modified by me - Examples modified in CY context
	L	Freq_SFW9	Publisher	Papa. 08	n.d.	Examples modified in CY context Papa. Category: use of specialized software applications
	M	Freq_SFW7	Hyperstudio (multimedia)	Papa. 08	.78 reliability	Examples modified in CY context Papa. Category: use of specialized software applications
	N	Freq_SFW10	Frontpage (webpage)	Papa. 08	.84 reliability	Examples modified in CY context Papa. Category: use of specialized software applications
	O	Freq_SFW8	Kidspiration (c-map)	Papa. 08	.78 reliability	Added "C-map" as example in Italian context Examples modified in CY context Papa. Category: use of specialized software applications
	P	Freq_SFW11	Logo (programming)	Papa. 08	n.d.	Examples modified in CY context Papa. Category: use of specialized software applications
	Q	Freq_SFW12	Model-it (modeling)	Papa. 08	.78 reliability	Examples modified in CY context Papa. Category: use of specialized software applications
	R	Freq_SFW14	Ed. CD	Papa. 08	n.d.	Examples modified in CY context Papa. Category: use of common software applications

PART			CONTENT	SOURCE	ORIGINAL RELIABILITY	NOTES
Part 4 Support	Title			Researcher		Modified in CY context
	Instructions			Researcher		Likert labels by Chris. 09; Sch. 09; Heit. 16
	A	Sup_ENCOUR1	Teachers encourage	Papa. 08	.86 reliability	Modified in CY context (many teachers, not "other

						teachers")
	B	Sup_ENCOUR2	Professors encourage	DeR. 15	n.d.	Modified in CY context (in my lessons)
	C	Sup_ENCOUR3	Colleagues encourage	DeR. 15	n.d.	
	D	Sup_ENCOUR4	Dear ones encourage	DeR. 15	n.d.	
	E	Sup_discussPeers	Talk ICT w peers	Papa. 08	.86 reliability	
	F	Sup_UNIex1	Teachers at uni use ICT in less	(Papa. 08)	n.d.	Other teachers in my school → professors in my university
	G	Sup_UNIthink	Uni makes me think ICT in my teach	(Sch. 09)	.78 α* internal consistency	*in original version. Teaching approaches I use in my classroom → teaching practices
	H	Sup_UNIaccess	Uni Access software	Papa. 08	.76 reliability	
	I	Sup_UNItechnical	Uni technical support	Papa. 08	.76 reliability	
	J	Sup_UNIinfrastr	Uni infrastructure	Papa. 08	.76 reliability	
	K	Sup_UNIex2	Uni good examples	(Ton. 16)	n.d.	Modified in: present tense + specification "in my university courses"
	L	Sup_UNIex3	Uni demonstrate ICT use	(Ton. 16)	n.d.	Modified in: present tense + specification "in my university courses"
	M	Sup_UNIdiscuss1	Uni discuss difficulties ICT integration	(Ton. 16)	n.d.	Modified in: present tense + specification "in my university courses"
	N	Sup_UNIdesign1	Uni help design courses w ICT	(Ton. 16)	n.d.	Modified in: present tense + specification "in my university courses"
	O	Sup_UNIdesign2	Uni help design digimat	(Ton. 16)	n.d.	Modified in: present tense + specification "in my university courses"
	P	Sup_UNIdesign3	Uni help develop ICT less	(Ton. 16)	n.d.	Modified in: present tense + specification "in my university courses"
	Q	Sup_UNIcoll	Uni possibilities coll w peers use ICT in teach	(Ton. 16)	n.d.	Modified in: present tense + specification "in my university courses"
	R	Sup_UNIdiscuss2	Uni discuss experience ICT in less	(Ton. 16)	n.d.	Modified in: present tense + specification "in my university courses"
	S	Sup_UNIdesign4	Uni possibilities test ICT in less	(Ton. 16)	n.d.	Modified in: present tense +

						specification “in my university courses”
	T	Sup_ENCOUR5	Uni encourage experience	(Ton. 16)	n.d.	Modified in: present tense + specification “in my university courses”
	U	Sup_UNIfeedb	Uni feedback use ICT in less	(Ton. 16)	n.d.	Modified in: present tense + specification “in my university courses” + added “design”

PART			**CONTENT**	**SOURCE**	**ORIGINAL RELIABILITY**	**NOTES**
Part 5 Attit.	Title			Papa. 08; Chris. 09		De.R. reports “technology acceptance”, would that be better?
	Instruction			Papa.09		Modified for CY context (3 months)
	A	Att_like	Like use	DeR.15	n.d.	Technologies → computer (CY context)
	B	Att_hardstop	Hard to stop	DeR.15	n.d.	Technological → ICT (CY context)
	C	Att_tense	Tense/ uncomfortable	Chris.09	.92 α Cronbach	Modified for CY context (computer)
	D	Att_irk	PC irks	Chris.09	.93 α Cronbach	Modified for CY context (computer)
	E	Att_noeffort	PC no mental effort	DeR. 15	n.d.	Modified for CY context (computer)
	F	Att_difficult	Difficult use	Chris.09	n.d.	Modified for CY context (computer) CY: negative (does not) NL: positive (does) IT: positive (does)
	G	Att_easy	Easy use	(DeR. 15)	n.d.	Maybe redundant Modified for CY context (computer)
	H	Att_frustr	Disappointing/ frustrating	Chris. 09	.77 α Cronbach	Modified for CY context (computer)
	I	Att_comf	Comfortable	Chris. 09	n.d.	Modified for CY context (computer)
	J	Att_easy2	Very easy use	Chris. 09	n.d.	Modified for CY context (computer)
	K	Att_upset	Upset	Chris. 09	.94 α Cronbach	Modified for CY context (upset)
	L	Att_noKtofix	Not K. to fix	Papa. 08	.82 reliability	
	M	Att_Ktofix	K. to find help	DeR.15	n.d.	Modified for CY context (computer)
	N	Att_ICTp1	Comfortable PC4Ed	Papa. 08	.89 reliability	Modified for CY context (computer)
	O	Att_ICTp2	PC4Ed anxious	Papa. 08	.82 reliability	Modified for CY context (computer) In CY: anxious/stressed In NL: scared In IT: stressed
	P	Att_ICTpNoUse	PC4Ed no use	Chris. 09	.88 α Cronbach	Modified for CY context (computer)

	Q	Att_exciting	Exciting	Papa. 08	.76reliability	Modified for CY context (computer)
	R	Att_worthy	How to use: worthy k.	Chris. 09	n.d.	Modified for CY context (computer)
	S	Att_ICTp3	PC4Ed skeptical	Papa. 08	.82 reliability	*If correctly understood in "anxiety" Modified for CY context (computer)
	T	Att_ICTp4	PC4Ed fear	Papa. 08	.82 reliability	Modified for CY context (computer)
	U	Att_ICTp5	PC4Ed valuable	Papa. 08	. 59 reliability	Modified for CY context (computer)
	V	Att_ICTpTeachQL1	PC4Ed improve Teach. QL	DeR. 15	n.d.	Modified for CY context (computer)
	W	Att_ICTpTeachQL2	PC4Ed change teach	Papa. 08	. 59 reliability	Modified for CY context (computer)
	X	Att_NoDiff	PC equal me	Papa. 08	.76reliability	Modified for CY context (computer)
	Y	Att_ICTp6	PC4Ed remedial	Chris. 09	.76 α Cronbach	Modified for CY context (computer)
	Z	Att_ICTpTeachQL3	PC4Ed presence improve Teach	Chris. 09	.76 α Cronbach	Modified for CY context (computer)
	Aa	Att_ICTpLearn1	PC4Ed change way learn	Papa. 08	. 59 reliability	Modified for CY context (computer)
	Bb	Att_ICTpCitizen	PC4Ed b citizens	Chris. 09	.80 α Cronbach	"Significance section"
	Cc	Att_ICTpLearn2	PC4Ed no learning no easy use	Papa. 08	.76 reliability	
	Dd	Att_ICTp7	PC4Ed helps understanding concepts effectively	Papa. 08	.76reliability	
	Ee	Att_ICTpALLb	PC4Ed for all b	Chris.09	.86 α Cronbach	"Significance section"
	Ff	Att_ICTp8	PC4Ed creativity	Chris.09	.76 α Cronbach	"Significance section"
	Gg	Att_ICTp9	PC4Ed improve writing	Chris.09	n.d.	Not in the latest version.
	Hh	Att_ICTpLearn3	PC4Ed learning styles	Chris.09	n.d.	Cannot find the analysis
	Ii	Att_ICTpLearn4	PC4Ed express thoughts	Papa. 08	.76 reliability	
	Jj	Att_ICTpTeachQL4	PC4Ed effective teach	Papa. 08	.76 reliability	
	Kk	Att_ICTpLearn5	PC4Ed no learn for techn. Probl.	Papa. 08	.76 reliability	

PART			**CONTENT**	**SOURCE**	**ORIGINAL RELIABILITY**	**NOTES**
Part 6 Self-eff	Title			Papa. 08		Modified in CY context
	Instructions			(Papa. 08)		Likert labels by Chris. 09; Sch. 09; Heit. 16
	A	Self_selectSFW	Select suitable soft	Papa. 08	.86 reliability	
	B	Self_DesignICTact	Design activities wICT	Papa. 08	.86* reliability	Modified in CY+NL context (no reference to technologies)

	C	Self_USE1	Use internet in less	Papa. 08	.86* reliability	Modified in CY context (no reference to learning goals)
	D	Self_USE2	Use email wb	(Papa. 08)	n.d.	Modified in CY context (no reference to colleagues)
	E	Self_USE3	Use social networks in less	(DeR. 15)	n.d.	
	F	Self_USE4	Use PowerPoint in less	(DeR. 15)	n.d.	
	G	Self_USE5	Use IWB in less	(DeR. 15)	n.d.	
	H	Self_DIGIMAT1	Assess digimat	Heit. 16	n.d.	
	I	Self_DIGIMAT2	Use digimat in less	Heit. 16	n.d.	
	J	Self_DIGIMAT3	Adapt digimat	(Heit.16)	n.d.	Modified by researcher
	K	Self_DIGIMAT4	Use digimat 4 content	DeR. 15	n.d.	Modified in CY context (no reference to different ways to present concepts)
	L	Self_adaptSFW	Adapt software to circumstances	Sch.09	.69α internal consistency	
	M	Self_ICT4content_ criticThink	Think critically ICT 4 content	Sch. 09; Heit. 16	. 75α* internal consistency	*From Sch. 09

PART			CONTENT	SOURCE	ORIGINAL RELIABILITY	NOTES
Part 7 TPCK	Title			Researcher		Modified in CY context
	Description			Yil. 16		
	Instructions			Researcher		Likert labels by Chris. 09; Sch. 09; Heit. 16
	1	TPCK.K_ICT1	K to use DigiTools	Yil. 16	n.d.	Modified in CY context ("I know how to use" instead of "I know")
	2	TPCK.K_ICT2	Technical skills	Yil. 16	n.d.	
	3	TPCK.Self_ICT1	K to fix	Yil. 16	n.d.	
	4	TPCK.K_ICT3	K of ICT up to date	Yil. 16	n.d.	
	5	TPCK.Self_ICT2	Learn ICT easily	Yil. 16	n.d.	
	6	TPCK.Freq_ICT1	Often explore new techn	Yil. 16	n.d.	
	7	TPCK.Self_ICT3	Confidence in use ICT	Yil. 16	n.d.	
	8	TPCK_ICT4L1	I can assess learning w ICT	Yil. 16	n.d.	
	9	TPCK _ICT4L2	Can explain b ICT charact	Yil.16	n.d.	
	Inner title					Modified in CY context (eliminated)

	1	TPCK_ICT4L3	Use ICT in learning	Yil. 16	n.d.	CY: in learning NL: in teaching profession IT: in learning
	2	TPCK_ICT4L4	Choose appropriate ICT for teach obj	Yil. 16	n.d.	
	3	TPCK_ICT4c1	Use ICT 4 content	Yil. 16	n.d.	
	4	TPCK_ICT4c2	Use ICT 4 learn content	Yil. 16	n.d.	
	5	TPCK_ICT4c3	ID content 4 ICT	Yil. 16	n.d.	
	6	TPCK_ICT4L5	ICT 4 b think	Yil. 16	n.d.	
	7	TPCK_ICT4p1	Design activities w ICT	Yil. 16	n.d.	
	8	TPCK_ICT4p2	Design ICT activities 4 M	Yil. 16	n.d.	
	9	TPCK_ICT4p3	ICT 4 diversify teaching	Yil. 16	n.d.	
	10	TPCK_ICT4p4	Design ICT activities 4 coll	Yil. 16	n.d.	
	11	TPCK.Integr1	Use combined C P T	Yil. 16	n.d.	
	12	TPCK.Integr2	Use content ICT 4 P	Yil. 16	n.d.	CY: support teaching approaches NL: support students' learning IT: support students' learning
	13	TPCK.Integr3	Use content ICT 4 C	Yil. 16	n.d.	
	14	TPCK.Integr4	Adapt ICT different activities	Yil. 16	n.d.	
	15	TPCK.Integr5	Use ICT 4 what how teach & Learn	Yil. 16	n.d.	
	16	TPCK.Integr6	Tailor activities 4 learn obj w ICT	Yil. 16	n.d.	
	17	TPCK.Integr7	Integrate ICT in less	Yil. 16	n.d.	Modified in CY context (generalized: I know how to integrate technologies in my lesson plans)

3.2 QUESTIONNAIRE INSTRUMENT

Note: what follows is the original questionnaire in English. Minor modifications in the lexicon could have been inserted in the three contexts, according to the native speakers' suggestions at the time of data collection.

ID number:__________________________

Please answer every question as best you can. Your honest answers will be greatly appreciated. Your personal information and answers will remain confidential. Your answers will in no way affect your degree in the course. Thank you very much for your cooperation.

Part 1 - Demographic information:

Please cross or write your answer in the space provided

1. Gender: ☐ Male ☐ Female
2. Age range: ☐ 17-22 ☐ 23-26 ☐ 27-32 ☐ 32+
3. Please state your year at University:
   - ☐ First year
   - ☐ Second Year
   - ☐ Third year
   - ☐ Fourth year
   - ☐ Fifth year
4. Have you attended vocational training courses other than the University of Cyprus courses on the integration of digital technology in teaching and learning?

   ☐ Yes ☐ No
5. Have you taught or teach now?
   - ☐ Yes: in the pre-primary school level
   - ☐ Yes: in the primary school level
   - ☐ Yes: in the lower secondary school level
   - ☐ Yes: in the secondary school level
   - ☐ Yes (other, please specify)____
   - ☐ No
6. If you answered YES to the above question, during your school career have you experimented with the use of digital technologies in teaching and learning? Yes: in each and every school level
   - ☐ Yes: in most school levels
   - ☐ Yes: only at some school level
   - ☐ No or very seldom in the different school levels
7. Do you have a home computer? ☐ Yes ☐ No

Part 2 – Knowledge of digital tools

Please, respond based on the following:
1. I don't know how to use it;
2. I can use it at a beginner level
3. I can use it satisfactorily
4. I can use it well
5. I can use it very well

		I don't know how to use it	I can use it at a beginner level	I can use it satisfactorily	I can use it well	I can use it very well
a)	Text editing (Word, Writer…)	①	②	③	④	⑤
b)	Spreadsheets (Excel, Numbers, Calc)	①	②	③	④	⑤
c)	Picture editing software (Paint, Photoshop, Flickr)	①	②	③	④	⑤
d)	Video making software (Moviemaker, iMovie)	①	②	③	④	⑤
e)	Presentation software (PowerPoint, Keynote, Impress)	①	②	③	④	⑤
f)	Interactive Whiteboards	①	②	③	④	⑤
g)	Mailing system	①	②	③	④	⑤
h)	Browsers on the internet (Explorer, Firefox, chrome…)	①	②	③	④	⑤
i)	Search engines on the internet (Google, Yahoo)	①	②	③	④	⑤
j)	Tools for the bibliographic research online (Google scholar, Scopus...)	①	②	③	④	⑤
k)	Platforms for remote collaboration on the internet (Wiki, forum, chat)	①	②	③	④	⑤
l)	Databases (Access)	①	②	③	④	⑤
m)	Tools for development of multimedia application (HyperStudio)	①	②	③	④	⑤
n)	Tools for Concept mapping (Kidspiration, Inspiration, C-Map)	①	②	③	④	⑤
o)	Electronic Publishing software (Publisher)	①	②	③	④	⑤
p)	Webpage authoring software (FrontPage)	①	②	③	④	⑤
q)	Programming languages (Logo, C)	①	②	③	④	⑤
r)	Modeling software (Model-It, Stella)	①	②	③	④	⑤
s)	Simulations (Stagecast Creator, Interactive Physics)	①	②	③	④	⑤

PART 3 – Frequency of use of digital technology for personal purposes.
Please note how often you use new technologies based on the following:

1. *Never*
2. *Once or twice every three months*
3. *Once or twice a month*
4. *Once or twice a week*
5. *Almost every day*

		Never	Once or twice every three months	Once or twice a month	Once or twice a week	Almost every day
a)	Engage on social networks with friends (Facebook, Twitter, Instagram…)	①	②	③	④	⑤
b)	Play games (FIFA, Solitaire)	①	②	③	④	⑤
c)	Process text (Word, Writer)	①	②	③	④	⑤
d)	Prepare spreadsheets (Excel, Numbers, Calc)	①	②	③	④	⑤
e)	Edit pictures (Paint, Photoshop, Flickr)	①	②	③	④	⑤
f)	Edit videos (Moviemaker, iMovie)	①	②	③	④	⑤
g)	Make presentations (PowerPoint, Keynote, Impress)	①	②	③	④	⑤
h)	Communicate (email)	①	②	③	④	⑤
i)	Access the internet	①	②	③	④	⑤
j)	Search for information online (Google scholar, Scopus, online journals)	①	②	③	④	⑤
k)	Collaborate with online communities (Wiki, forum, chat)	①	②	③	④	⑤
l)	Publish (Publisher)	①	②	③	④	⑤
m)	Develop multimedia (Hyperstudio)	①	②	③	④	⑤
n)	Develop web pages (FrontPage)	①	②	③	④	⑤
o)	Map concepts (Kidspiration, Inspiration, C-Map)	①	②	③	④	⑤
p)	Program the computer (Logo, C)	①	②	③	④	⑤
q)	Model complex systems (Model-it, Stella)	①	②	③	④	⑤
r)	Use educational CDs	①	②	③	④	⑤

Part 4 – Support for the use of digital technology.

Please note the extent of your agreement or disagreement with the following suggestions considering

1. *strongly disagree;*
2. *disagree;*
3. *neutral;*
4. *agree;*
5. *strongly agree.*

		I strongly disagree	I disagree	Neutral	I agree	I strongly agree
a)	many teachers encourage me to integrate computers in my lessons	①	②	③	④	⑤
b)	My professors encourage me to integrate computers in my lessons	①	②	③	④	⑤
c)	My colleague student teachers encourage me to integrate computers in teaching and learning	①	②	③	④	⑤
d)	My dear ones encourage me to integrate computers in teaching and learning	①	②	③	④	⑤
e)	I often talk about using digital technology with my fellow students	①	②	③	④	⑤
f)	There are professors in my university who use computers in teaching and learning	①	②	③	④	⑤
g)	My university program has caused me to think more deeply about how technology could change my teachings	①	②	③	④	⑤
h)	A variety of computer software is available for use in my university	①	②	③	④	⑤
i)	The technical support in my university is adequate	①	②	③	④	⑤
j)	The technical infrastructure in my university is adequate	①	②	③	④	⑤
k)	In my university courses I see good examples of digital technology practice that inspire me to use them in my teaching too	①	②	③	④	⑤
l)	In my university courses the potential of digital technology use in education is demonstrated concretely	①	②	③	④	⑤
m)	In my university courses we discuss the challenges of integrating digital technology in education	①	②	③	④	⑤
n)	In my university courses I receive sufficient help in designing lessons that integrate digital technology	①	②	③	④	⑤
o)	In my university courses we receive help to use digital technology when developing educational materials	①	②	③	④	⑤
p)	In my university courses I receive a great deal of help in developing ICT-rich lessons and projects	①	②	③	④	⑤
q)	In my university courses there are enough occasions for me to work together with other students on digital technology use in education (e.g. we develop ICT-based lessons together)	①	②	③	④	⑤
r)	In my university courses we discuss experiences about the use of digital technologies in teaching	①	②	③	④	⑤
s)	In my university courses there are enough occasions for me to test different ways of using digital technology in the classroom	①	②	③	④	⑤
t)	In my university courses I am encouraged to gain experience in using digital technology in a classroom setting	①	②	③	④	⑤
u)	In my university courses I receive sufficient feedback about the use of digital technology in my lesson designs	①	②	③	④	⑤

Part 5 – Attitudes towards digital technology

Please note the degree of agreement or disagreement with the following suggestions using the following:

1. *strongly disagree;*
2. *disagree;*
3. *neutral;*
4. *agree;*
5. *strongly agree.*

		I strongly disagree	I disagree	Neutral	I agree	I strongly agree
a)	I like using the computer	①	②	③	④	⑤
b)	Whenever I start using a new ICT software, I find it hard to stop	①	②	③	④	⑤
c)	Working with the computer makes me feel tense and uncomfortable	①	②	③	④	⑤
d)	Working with a computer makes me nervous	①	②	③	④	⑤
e)	Dealing with computers does not require me a huge mental effort	①	②	③	④	⑤
f)	Computers are difficult to use	①	②	③	④	⑤
g)	I find it easy to use computers	①	②	③	④	⑤
h)	Using a computer is very frustrating	①	②	③	④	⑤
i)	I feel comfortable working with a computer	①	②	③	④	⑤
j)	I think computers are very easy to use	①	②	③	④	⑤
k)	I am upset when I think of trying to use a computer	①	②	③	④	⑤
l)	If something goes wrong I will not know how to fix it	①	②	③	④	⑤
m)	Whenever I need help in using the computer I know where to find proper assistance (manuals, tutorials, instructions, experts…)	①	②	③	④	⑤
n)	I feel comfortable with the idea of computer as tool in teaching and learning	①	②	③	④	⑤
o)	The use of computer in teaching and learning stresses me out	①	②	③	④	⑤
p)	I can't think of any way that I will use computers in my career	①	②	③	④	⑤
q)	The use of the computer as a learning tool excites me	①	②	③	④	⑤
r)	Knowing how to use a computer is a worthwhile skill	①	②	③	④	⑤
s)	The idea of using a computer in teaching and learning makes me skeptical	①	②	③	④	⑤
t)	The use of computers in teaching and learning scares me	①	②	③	④	⑤
u)	The computer is a valuable tool for the teachers	①	②	③	④	⑤
v)	The quality of my teaching will improve with the use of my PC	①	②	③	④	⑤
w)	The computer will change the way I teach	①	②	③	④	⑤
x)	I can do what the computer can do equally as well	①	②	③	④	⑤
y)	The computer could enhance remedial instruction	①	②	③	④	⑤

	(continued)	I strongly disagree	I disagree	Neutral	I agree	I strongly agree
z)	If there was a computer in my classroom it would help me to be a better teacher	①	②	③	④	⑤
aa)	The computer will change the way students learn in my classes	①	②	③	④	⑤
bb)	It is important for students to learn about computers in order to be informed citizens	①	②	③	④	⑤
cc)	The computer is not conducive to student learning because it is not easy to use	①	②	③	④	⑤
dd)	The computer helps students understand concepts in more effective ways	①	②	③	④	⑤
ee)	All students should have an opportunity to learn about computers at school	①	②	③	④	⑤
ff)	Computers could stimulate creativity in students	①	②	③	④	⑤
gg)	Computers could help students improve their writing	①	②	③	④	⑤
hh)	Computers can help accommodate different learning styles	①	②	③	④	⑤
ii)	The computer helps students learn because it allows them to express their thinking in better and different ways	①	②	③	④	⑤
jj)	The computer helps teachers to teach in more effective ways	①	②	③	④	⑤
kk)	The computer is not conducive to good teaching because it creates technical problems	①	②	③	④	⑤

PART 6 – Perceived self-confidence in integrating ICT.

Please note the extent of your agreement or disagreement with the following suggestions considering

1: strongly disagree;

2: disagree;

3: neutral;

4: agree;

5: strongly agree.

I feel confident that….	I strongly Disagree	I disagree	Neutral	I agree	I strongly agree
a) I can select appropriate software to use in my lessons	①	②	③	④	⑤
b) I can design learning activities for my students	①	②	③	④	⑤
c) I can use the internet in my lessons	①	②	③	④	⑤
d) I can use emails to communicate with my students	①	②	③	④	⑤
e) I can use social networks in my teaching	①	②	③	④	⑤
f) I can use PowerPoint in my teaching	①	②	③	④	⑤
g) I can use Interactive Whiteboards in my teaching	①	②	③	④	⑤
h) I can assess the use of digital learning materials	①	②	③	④	⑤
i) I can use digital learning materials in my teaching	①	②	③	④	⑤
j) I can customize activities with the computer in different circumstances	①	②	③	④	⑤
k) I can use digital technologies to present concepts	①	②	③	④	⑤
l) I can adapt the use of digital technologies I am learning about, to different teaching activities	①	②	③	④	⑤
m) I can think critically about how to use technologies in my teaching	①	②	③	④	⑤

PART 7 – Teaching with digital technologies

Please note the extent of your agreement or disagreement with the following suggestions considering

1. *1: strongly disagree;*
2. *2: disagree;*
3. *3: neutral;*
4. *4: agree;*
5. *5: strongly agree.*

Knowledge of Technology	I strongly disagree	I disagree	Neutral	I agree	I strongly agree
1. I know to use about a lot of different technological tools	①	②	③	④	⑤
2. I have the technical skills needed to use different technologies	①	②	③	④	⑤
3. I know how to solve my own technical problems	①	②	③	④	⑤
4. My knowledge of new technologies is up-to-date	①	②	③	④	⑤
5. I learn to use new technologies easily	①	②	③	④	⑤
6. I explore new technologies frequently	①	②	③	④	⑤
7. I have confidence in my ability to work with different technologies	①	②	③	④	⑤
8. I know how to use technology to assess student work	①	②	③	④	⑤
9. I know how to explain the specifics of using different technologies to students	①	②	③	④	⑤

Knowledge of Teaching with Curriculum-Based Technology

1. I know about technologies that I can use for student learning in my curriculum area(s)	①	②	③	④	⑤
2. I can choose technologies that fit with learning goals in my curriculum area(s).	①	②	③	④	⑤
3. I can use technologies that are specific to my curriculum area(s).	①	②	③	④	⑤
4. I can use technologies to support student learning in my curriculum area(s).	①	②	③	④	⑤
5. I can identify specific topics in my curriculum area(s) where technologies support learning of the topics.	①	②	③	④	⑤
6. I can envision how students reason when using technology in my curriculum area(s).	①	②	③	④	⑤
7. I know how to design classroom activities that integrate technologies as learning tools.	①	②	③	④	⑤

8. I know how to design technology-based classroom activities that motivate students	①	②	③	④	⑤
9. I know how to use technologies to differentiate instruction	①	②	③	④	⑤
10. I know how to design technology-based classroom activities to support student collaboration.	①	②	③	④	⑤
11. I can use instructional strategies that combine curriculum, technologies, and teaching approaches to support student learning	①	②	③	④	⑤
12. I can use curriculum-based technologies that enhance the teaching approaches in my curriculum area(s) to support student learning	①	②	③	④	⑤
13. I can use curriculum-based technologies that support student understanding, thinking and learning in my curriculum area(s)	①	②	③	④	⑤
14. I can adapt the uses of particular technologies to different teaching activities in my curriculum area(s)	①	②	③	④	⑤
15. I can use technology to improve what I teach, how I teach and what students learn	①	②	③	④	⑤
16. I can adapt the contents to achieve the objectives of teaching with the help of technology	①	②	③	④	⑤
17. I can integrate technology into teaching my lessons	①	②	③	④	⑤

3.3 Questionnaire factor analysis

EFA pre questionnaire
Knowledge of technology
(PT 2 quest: TK)
Reliability
Run reliability on **section** (Chronbach's α= .896).
All factors, 19 items, α= .896
Found 3 factors explaining 57.383% variance (each factor with reliability α>= .82). Considering the original sources for the questionnaire. Factors are in line with original sources as for items included.

Item-Total Statistics				
α= .896	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
K_SFW1	46,29	95,366	,616	,889
K_SFW2	47,37	93,432	,526	,891
K_SFW3	47,60	90,257	,643	,886
K_SFW4	48,00	89,606	,600	,888
K_SFW5	46,73	92,568	,627	,887
K_HDW1	48,03	93,813	,423	,895
K_INT1	46,23	98,413	,400	,894
K_INT2	46,21	96,607	,508	,891
K_INT3	46,09	97,571	,548	,891
K_INT4	47,86	89,941	,523	,892
K_INT5	48,01	92,057	,534	,891
K_SFW6	48,44	90,300	,612	,888
K_SFW7	49,12	95,473	,601	,889
K_SFW8	48,58	92,192	,567	,889
K_SFW9	49,12	95,591	,527	,891
K_SFW10	49,22	96,871	,544	,891
K_SFW11	49,22	96,803	,521	,891
K_SFW12	49,34	98,651	,508	,892
K_SFW13	49,39	98,996	,484	,893

(a) **Higher order/level digital applications and software** α= .84 (8):
SFW.7-13; HDW.1 (weak: without .856)
interactive whiteboard, multimedia software (e.g. Hyperstudio), concept mapping tools (e.g. Kidspiration, C-map), electronic publishing tools (e.g. Publisher, FrontPage), programming languages, modelling and simulations (e.g. Model-it, Stagecast);

(b) ***Lower order/level / information gathering/production*** **applications and software** α= .84 (8):
SFW 1-6; INT.4, 5
Office suite (word, excel, PowerPoint), Paint, MovieMaker, databases, tools for bibliographic research online (e.g. Scholar), platforms for remote collaboration (e.g. wiki, forums)

(c) **Common internet application / software** α= .82 (3):
INT 1-3
Email system, internet browsers (e.g. Chrome), internet search engines (e.g. Google)

Rotated Component Matrix[a]

Overall α= .896	Component 1	2	3
K_SFW12	,889		
K_SFW13	,866		
K_SFW10	,820		
K_SFW11	,749		
K_SFW9	,638	,343	
K_SFW7	,605	,472	
K_SFW8	,443	,337	,314
K_HDW1	,365		
K_SFW4		,706	
K_SFW6	,304	,703	
K_SFW3		,661	,313
K_SFW2		,661	
K_SFW5		,654	,394
K_SFW1		,599	,488
K_INT5		,499	
K_INT4		,485	
K_INT2			,816
K_INT3			,813
K_INT1			,801

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 6 iterations.

Item-Total Statistics

F1: α= .84 (8), 22.070% var.	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
K_HDW1	10,22	14,526	,392	,857
K_SFW7	11,31	15,208	,628	,809
K_SFW8	10,76	14,324	,500	,831
K_SFW9	11,30	14,844	,614	,810
K_SFW10	11,41	15,115	,711	,801
K_SFW11	11,41	15,356	,622	,810
K_SFW12	11,53	15,791	,726	,806
K_SFW13	11,58	16,027	,680	,810

Item-Total Statistics

F2: α= .842 (8), 20.526% var.	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
K_SFW6	22,51	26,965	,570	,824
K_SFW2	21,43	27,867	,559	,825
K_SFW3	21,64	26,202	,673	,810
K_SFW4	22,01	25,657	,627	,816
K_SFW5	20,78	27,660	,640	,816
K_SFW1	20,34	29,317	,636	,822
K_INT4	21,91	26,620	,484	,839
K_INT5	22,05	27,737	,507	,832

Item-Total Statistics

F3: α= .823 (3), 14.788% var.	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
K_INT1	8,95	1,599	,591	,845
K_INT2	8,91	1,403	,709	,726
K_INT3	8,79	1,630	,756	,694

EFA – Frequency of use of technology: access

(PT 3 quest: Freq TK) α= .772 (18):

Analysed as a descriptive measure of the access to technologies. It is observed through the lens of the 3 factors of previous section, to gather more background information that could contribute to the knowledge of use of technologies. When in doubt, for different items in section 2 than in section 1, used original sources' classification.

Factors:

(a) **Lower order/ level / information gathering/ production applications and software** (FREQ.SFW.1-5; FREQ.SFW.14; INT.4-5): Office suite (word, excel, Powerpoint), Paint, MovieMaker, using educational CD; tools for bibliographic research online (e.g. Google scholar), platforms for remote collaboration (e.g. wiki, forum), databases

(b) **Higher order/ level applications and software** (FREQ._SFW.7-12): multimedia software (e.g. Hyperstudio), concept mapping tools (e.g. Kidspiration, C-map), electronic publishing tools (e.g. Publisher, FrontPage), programming languages, modelling and simulations (e.g. Model-it, Stagecast);

(c) **Common internet applications** (FREQ._INT 1, 6): email system, surfing the internet

(d) **Leisure use of technologies** (FREQ._PERS.1-2), as gaming apps (e.g. Solitaire) and social tools (e.g. Twitter).

Item-Total Statistics

Overall α= .772 (18):	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Freq_Pers1	39,70	54,863	,170	,773
Freq_Pers2	42,44	51,897	,225	,775
Freq_SFW1	40,49	50,699	,424	,755
Freq_SFW2	42,10	49,572	,470	,751
Freq_SFW3	42,01	48,122	,555	,743
Freq_SFW4	42,62	50,435	,511	,750
Freq_SFW5	41,51	49,734	,468	,751
Freq_INT1	40,14	52,940	,300	,765
Freq_INT6	39,47	56,904	,183	,772
Freq_INT4	40,77	50,435	,242	,779
Freq_INT5	42,30	47,517	,464	,751
Freq_SFW9	42,83	50,753	,393	,758
Freq_SFW7	43,23	54,142	,453	,760
Freq_SFW10	43,28	55,562	,286	,767
Freq_SFW8	42,79	51,527	,389	,758
Freq_SFW11	43,31	55,486	,355	,766
Freq_SFW12	43,34	55,897	,329	,767
Freq_SFW14	42,76	51,568	,413	,757

EFA – Contextual support
(PT 4 quest: Contex) α= .928 (21):
Analysis of Part 6. Support, α= .93 (21)
Exploratory Factor analysis gives 4 factors with different reliabilities. Considering the sources and theoretical references, the most sensible choice seems the 3 factor analysis. Variance explained: 57.322%. (F1: 27.821%, F2 16.490%, F3 13.012%)

a) **university's active role in supporting students**: α= .920 (9). Explains 27.821% variance: UNIdiscuss 1,2; UNIdesign1-4; UNIfeedb; ENCOUR5; UNIcoll
    - in my university courses we discuss the challenges of integrating digital technology in education"
    - in my university courses we discuss experiences about the use of digital technologies in teaching;
    - in my university courses I receive sufficient help in designing lessons that integrate digital technology;
    - in my university courses we receive help to use digital technology when developing educational materials
    - in my university courses I receive a great help in developing ICT-rich lessons and projects;
    - in my university courses there are enough occasions for me to test different ways of using digital technology in the classroom;
    - in my university courses I receive sufficient feedback about the use of digital technology in my lesson design
    - in my university courses I am encouraged to gain experience in using digital technology in a classroom;
    - in my university courses there are enough occasions for me to work together with other students on digital technology use in education.

b) **surrounding encouragement:** α= .787 (8). Explains 16.490% variance: ENCOUR1-4, DiscussPeers, UNIex1,3, UNIthink
    - many teachers encourage me to integrate computers in my lessons;
    - my professors encourage me to integrate computers in my lessons;
    - my colleagues encourage me to integrate computers in my lessons;
    - my dear ones encourage me to integrate computers in my lessons;
    - I often talk about using digital technology with my fellow students;
    - there are professors in my university who use computers in teaching and learning;
    - in my university courses the potential of digital technology use in education is demonstrated concretely;
    - my university program caused me to think more deeply about how technology could change my teaching.

c) **equipment and use**: α= .832 (4). Explains 13.012% variance: UNIaccess; UNItechnical; UNIinfractr; UNIex2
    - a variety of computer software is available for use in my university;

- the technical support in my university is adequate;
- the technical infrastructure in my university is adequate;
- in my university courses I see good examples of digital technology practice that inspire me to use them in my teaching too.

Item-Total Statistics

Overall α= .928 (21)	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Sup_ENCOUR1	65,78	150,181	,530	,926
Sup_ENCOUR2	65,44	152,528	,491	,927
Sup_ENCOUR3	65,86	151,399	,528	,926
Sup_ENCOUR4	66,13	151,964	,477	,927
Sup_discussPeers	66,31	151,374	,427	,929
Sup_UNIex1	64,77	158,283	,311	,929
Sup_UNIthink	65,23	153,568	,417	,928
Sup_UNIaccess	65,81	146,917	,636	,924
Sup_UNItechnical	65,90	149,181	,603	,925
Sup_UNIinfrastr	65,89	150,334	,522	,926
Sup_UNIex2	65,68	147,123	,680	,923
Sup_UNIex3	65,84	147,486	,644	,924
Sup_UNIdiscuss1	65,85	149,730	,512	,927
Sup_UNIdesign1	66,25	147,203	,667	,924
Sup_UNIdesign2	65,91	146,837	,668	,924
Sup_UNIdesign3	66,14	145,188	,721	,922
Sup_UNIcoll	65,91	145,967	,668	,924
Sup_UNIdiscuss2	66,16	144,920	,732	,922
Sup_UNIdesign4	66,18	145,337	,702	,923
Sup_ENCOUR5	65,82	144,200	,770	,921
Sup_UNIfeedb	66,25	145,730	,711	,923

Rotated Component Matrix[a]

	Component		
	1	2	3
Sup_UNIdiscuss2	,813		
Sup_UNIfeedb	,804		
Sup_UNIdesign1	,801		
Sup_UNIdesign4	,795		
Sup_UNIdesign3	,751		
Sup_ENCOUR5	,741	,326	
Sup_UNIcoll	,677		
Sup_UNIdesign2	,644		
Sup_UNIdiscuss1	,485	,436	
Sup_ENCOUR2		,756	
Sup_ENCOUR3		,706	
Sup_ENCOUR1		,672	
Sup_UNIthink		,592	
Sup_UNIex1		,525	,326
Sup_ENCOUR4	,317	,467	
Sup_UNIex3	,419	,432	,368
Sup_discussPeers	,356	,370	
Sup_UNItechnical			,862
Sup_UNIinfrastr			,841
Sup_UNIaccess	,424		,586
Sup_UNIex2	,440	,377	,479

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 6 iterations.

Item-Total Statistics				
F1 α= .920 (9). 27.821% var.	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Sup_UNIcoll	24,72	38,643	,680	,914
Sup_ENCOUR5	24,63	37,852	,779	,907
Sup_UNIdesign1	25,06	38,492	,759	,908
Sup_UNIdesign2	24,72	39,129	,680	,913
Sup_UNIdesign3	24,95	37,931	,767	,908
Sup_UNIdesign4	24,99	37,815	,760	,908
Sup_UNIdiscuss1	24,67	41,059	,478	,927
Sup_UNIdiscuss2	24,97	37,655	,789	,906
Sup_UNIfeedb	25,07	38,141	,765	,908

Item-Total Statistics				
F2: α= .787 (8). 16.490% var.	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Sup_discussPeers	25,05	16,098	,401	,783
Sup_ENCOUR1	24,52	15,329	,585	,748
Sup_ENCOUR2	24,19	15,984	,578	,751
Sup_ENCOUR3	24,60	15,576	,620	,744
Sup_ENCOUR4	24,88	16,245	,481	,766
Sup_UNIex1	23,52	18,300	,365	,782
Sup_UNIex3	24,58	15,901	,489	,765
Sup_UNIthink	23,98	16,585	,451	,770

Item-Total Statistics				
F3: : α= .832 (4). 13.012% var.	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Sup_UNIaccess	10,02	5,773	,602	,816
Sup_UNItechnical	10,11	5,462	,790	,731
Sup_UNIinfrastr	10,11	5,579	,708	,767
Sup_UNIex2	9,89	6,194	,559	,832

EFA –Attitudes towards Technologies

(PT 5 Quest: ATT)

Too many factors to run reliability as if it was only one scale (α= .647 (37)). It's possible it is measuring multiple things, different ones, so that's why it comes out low.

Running EFA on all the items, eigenvalue >1, comes out 8 factors. Considering literature and practicability, tried 4 and 5 factors, then 3.

Hypothesis with 3 factors seems more reasonable and higher Chronbach's. Variance explained: 45,503%.

a) **Complex factor: Emotive signposts**
17.751% variance

If considered all together, all positive, "Positive attitudes" [Comf, like, easy, easy2, ICTp1, KtoFix, hardstop, (-)Tense, (-)irk, (-)frustr, (-)upset, (-)noKtofix, (-)ICTp2, (-)ICTp4, (-)difficult**]** α= .903 (15)

i. **Emotive barriers, stress** α= .87 (8)

Tense, irk, frustr, upset, noKtofix, ICTp2, ICTp4, difficult

- □ Working with the computer makes me feel tense and uncomfortable;
- □ Working with a computer makes me nervous;
- □ Using a computer is very frustrating;
- □ I am upset when I think of trying to use a computer;
- □ If something goes wrong I will not know how to fix it;
- □ The use of computer in teaching and learning stresses me out;
- □ The use of computers in teaching and learning scares me;
- □ Computers are difficult to use.

ii. **Emotive enablers, comfort** α= .82 (7)

Comf, like, easy, easy2, ICTp1, KtoFix, hardstop

- □ I feel comfortable with working with a computer;
- □ I like using the computer;
- □ I find it easy to use computers;
- □ I think computers are very easy to use;
- □ I feel comfortable with the idea of computer as a tool in teaching and learning;
- □ Whenever I need help om using the computer I know where to find proper assistance (manuals, tutorials, instructions, experts);
- □ Whenever I start using a new ICT software, I find it hard to stop.

b) **ICT impact on teaching and learning** α= .904 (16)

ICTpTeachQL 1-4; ICTpLearn 1, 3, 4; ICTp 5-9; ICTpALLb, ICTpCitizen, worthy, exciting

- □ the quality of my teaching will improve with the use of my PC;
- □ the computer will change the way I teach;
- □ if there was a computer in my classroom it would help me being a better teacher:
- □ the computer helps teacher to teach in more effective ways;
- □ the computer will change the way students learn in my classes;
- □ computers can help accommodate different learning styles;
- □ the computer helps students learn because it allows them to express their thinking in better and different ways;
- □ the computer is a valuable tool for teachers;
- □ The computer could enhance remedial instruction;
- □ the computer helps students understand concepts in more effective ways;

- computers could stimulate creativity in students;
- computers could help students improve their writing;
- all students should have an opportunity to learn about computers at school;
- it is important for students to learn about computers in order to be informed citizens;
- knowing how to use a computer is a worthwhile skill;
- the use of computer as a learning tool excites me.

c) **lack of worth of ICT** α= .704 (5)

ICTp3, ICTpLearn 2, 5 ; ICTpNoUse; noDiff

- the idea of using a computer in teaching and learning makes me sceptical
- the computer is not conducive to student learning because it is not easy to use,
- the computer is not conducive to good teaching because it creates technical problems
- I can't think of any way that I will use computers in my career;
- I can do what the computer can do equally as well

Item-Total Statistics

F1 complex α= .903 (15), 17.751% var.	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Att_comf	53,5520	73,270	,741	,891
Att_easy	53,5341	74,516	,594	,896
Att_easy2	53,7742	73,147	,647	,894
Att_ICTp1	53,5161	75,287	,600	,896
Att_like	53,1649	76,153	,666	,895
Att_Ktofix	53,7742	77,593	,371	,905
Att_hardstop	54,5663	79,268	,332	,905
Att_tenseREV	53,3190	73,089	,705	,892
Att_irkREV	53,4158	72,416	,683	,893
Att_frustrREV	53,0860	74,942	,677	,894
Att_upsetREV	53,0896	75,017	,633	,895
Att_noKtofixREV	53,9068	74,394	,569	,897
Att_ICTp2REV	53,4516	75,342	,546	,898
Att_ICTp4REV	53,3835	75,237	,561	,897
Att_difficultREV	53,4337	76,282	,541	,898

Rotated Component Matrix[a]

	Component		
	1	2	3
Att_comf	,794		
Att_like	,733		
Att_easy2	,729		
Att_tense	-,724		,353
Att_irk	-,723		
Att_frustr	-,686		,333
Att_easy	,666		
Att_upset	-,640		,352
Att_noKtofix	-,623		
Att_ICTp1	,589	,356	
Att_ICTp4	-,554		,333
Att_difficult	-,553		
Att_ICTp2	-,526		,323
Att_Ktofix	,466		
Att_hardstop	,381	,324	
Att_noeffort			
Att_ICTpTeachQL3		,760	
Att_ICTpTeachQL4		,718	
Att_ICTpTeachQL2		,700	
Att_ICTpTeachQL1		,690	
Att_ICTpLearn1		,683	
Att_ICTp6		,661	
Att_ICTp7		,652	
Att_ICTp8		,647	
Att_ICTpLearn4		,626	-,308
Att_ICTpLearn3		,607	-,327
Att_ICTp9		,512	
Att_ICTpALLb		,499	-,459
Att_ICTpCitizen		,477	
Att_ICTp5		,470	-,409
Att_exciting		,437	
Att_worthy		,398	-,395
Att_ICTp3			,683
Att_ICTpLearn2			,667
Att_ICTpLearn5			,631
Att_ICTpNoUse			,548
Att_NoDiff			,328

	Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.
	a. Rotation converged in 6 iterations.

Item-Total Statistics

F1a α=.869 (8)	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Att_tense	14,26	22,580	,750	,838
Att_irk	14,17	22,256	,713	,842
Att_frustr	14,50	24,044	,670	,849
Att_upset	14,50	23,629	,681	,847
Att_noKtofix	13,67	23,609	,558	,861
Att_ICTp4	14,21	23,986	,568	,859
Att_difficult	14,15	24,923	,511	,864
Att_ICTp2	14,14	24,070	,549	,861

Item-Total Statistics

F1b α= .818 (7)	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Att_comf	21,84	15,208	,674	,774
Att_like	21,43	16,133	,662	,781
Att_easy2	22,05	14,533	,659	,775
Att_easy	21,81	15,252	,588	,788
Att_ICTp1	21,80	15,944	,552	,795
Att_Ktofix	22,05	15,980	,437	,817
Att_hardstop	22,84	16,981	,386	,821

Item-Total Statistics

F2: α= .904 (16) 17.22% var.	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Att_ICTpTeachQL1	58,61	59,632	,677	,895
Att_ICTpTeachQL2	58,62	61,466	,567	,899
Att_ICTpTeachQL3	58,96	58,748	,675	,895
Att_ICTpTeachQL4	58,62	60,423	,690	,895
Att_ICTpLearn1	58,69	61,400	,580	,899
Att_ICTp6	58,41	60,899	,647	,897
Att_ICTp7	58,57	60,817	,610	,898
Att_ICTp8	58,40	60,048	,650	,896
Att_ICTp9	58,99	60,536	,480	,903
Att_ICTpLearn3	58,36	61,673	,626	,897
Att_ICTpLearn4	58,76	59,768	,614	,897

Att_ICTp5	58,19	62,066	,515	,901
Att_worthy	57,78	64,267	,460	,902
Att_exciting	58,86	61,246	,474	,903
Att_ICTpALLb	58,00	62,039	,603	,898
Att_ICTpCitizen	58,23	62,557	,470	,902

Item-Total Statistics

F3 α= .704 (5), 10.030% var.	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Att_ICTp3	7,80	4,559	,532	,630
Att_ICTpLearn2	8,11	5,911	,530	,636
Att_ICTpLearn5	7,91	5,606	,557	,620
Att_ICTpNoUse	8,22	5,858	,446	,662
Att_NoDiff	7,52	6,272	,297	,719

EFA – Self-Efficacy
(PT 6 Quest: self-conf)
Reliability overall: α = .894 (13), weakest are USE 2 (α= .915) and USE 3 (α= .898)
Running EFA on all the items, eigenvalue >1, comes out 2 factors. Looking at rotated matrix and at original sources, 2 factors seems sensible. Self_USE 2,3,4 have weak reliability when run on entire scale, low reliability when run among themselves (as factor coming out of EFA: α= .331), so are deleted.
2 factors explain 60.094% variance.

a) **Perceived self-efficacy in integrating ICT: 49.437% of variance**
SelectSFW, DesignICTact, USE1, 5; DIGIMAT 1-4; adaptSFW, ICT4content_criticThink. α= .927 (10)
- I can select appropriate software to use in my lessons;
- I can design learning activities for my students, using ICT;
- I can use the Internet in my lessons;
- I can use Interactive Whiteboards in my teaching;
- I can assess the use of digital learning materials;
- I can use digital learning materials in my teaching;
- I can customize activities with the computer in different circumstances;
- I can use digital technologies to present concepts;
- I can adapt the use of digital technologies I am learning about, to different teaching activities;
- I can think critically about how to use technologies in my teaching.

Rotated Component Matrix[a]

	Component 1	Component 2
Self_DesignICTact	,865	
Self_selectSFW	,832	
Self_DIGIMAT3	,830	
Self_DIGIMAT2	,810	
Self_DIGIMAT4	,764	
Self_adaptSFW	,754	
Self_DIGIMAT1	,752	
Self_USE5	,715	
Self_ICT4content_criticThink	,681	
Self_USE1	,540	,474
Self_USE2	-,304	,806
Self_USE3		,601
Self_USE4		,516

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 3 iterations.

Item-Total Statistics

F1 α= .927 (10) 49.437% var.	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Self_adaptSFW	31,46	51,161	,730	,919
Self_DesignICTact	31,67	47,668	,800	,915
Self_DIGIMAT1	31,62	50,757	,720	,920
Self_DIGIMAT2	31,55	49,301	,812	,915
Self_DIGIMAT3	31,60	48,768	,804	,915
Self_DIGIMAT4	31,34	50,654	,755	,918
Self_ICT4content_criticThink	31,43	51,805	,609	,925
Self_selectSFW	31,66	47,633	,761	,918
Self_USE1	31,38	53,269	,573	,927
Self_USE5	31,28	49,841	,647	,924

EFA – TPCK
(PT 7 Quest: TPCK)
Section reliability: α=.967 (26)

Original source talks about 2 factors: F1 = knowledge of teaching with curriculum based ICT; F2 = knowledge of technology.
Considering multiple EFA runs and theoretical premises, the 2 factor section seems sensible. It results almost identical to original sources.

a) **TPCK in practice** explains 35.69% variance. α=.95 (18)
   Integr1-7; ICT4c1-3; ICT4L 2-5; ICT4p 1-4
   - I can use curriculum-based strategies that combine curriculum, technologies, and teaching approaches to support student learning;
   - I can use curriculum-based technologies that enhance the teaching approaches in my curriculum area(s) to support student learning;
   - I can use curriculum-based technologies that support student understanding, thinking and learning in my curriculum area(s);
   - I can adapt the use of particular technologies to different teaching activities in my curriculum area(s);
   - I can use technology to improve what I teach, how I teach and what students learn;
   - I can adapt the contents to achieve the objectives of teaching with the help of technology;
   - I can integrate technology into teaching my lessons;
   - I can use technologies that are specific to my curriculum area(s);
   - I can use technologies to support student learning in my curriculum area(s);
   - I can identify specific topics in my curriculum area(s) where technologies support the learning of the topic;
   - I know how to explain the specifics of using different technologies to students;
   - I know about technologies that I can use for students learning in my curriculum area(s);
   - I can choose technologies that fit with learning goals in my curriculum area(s);
   - I can envision how students reason when using technology in my curriculum area(s);
   - I know how to design classroom activities that integrate technologies as learning tools;
   - I know how to design technology-based classroom activities that motivate students;
   - I know how to use technologies to differentiate instruction;
   - I know how to design technology-based classroom activities to support student collaboration.

b) **TPCK awareness** explains 16.24% of variance. α=.82 (8)
   Freq ICT1; K_ICT1-3; Self_ICT1-3; ICT4L1
   - I explore new technologies frequently;
   - I know about a lot of different technological tools;
   - I have the technical skills needed to use different technologies;
   - My knowledge of new technologies is up-to-date;
   - I know how to solve my own technical problems;
   - I learn to use new technologies easily;
   - I have confidence in my ability to work with different technologies;
   - I know how to use technology to assess student work.

Rotated Component Matrix[a]

Overall α= .967 (26)	Component 1	Component 2
TPCK.Integr2	,882	
TPCK.Integr3	,880	
TPCK.Integr6	,874	
TPCK.Integr5	,865	
TPCK.Integr1	,860	
TPCK.Integr4	,859	
TPCK_ICT4p4	,854	
TPCK_ICT4p1	,848	
TPCK_ICT4p2	,834	
TPCK_ICT4p3	,831	
TPCK_ICT4c2	,830	
TPCK_ICT4L4	,819	,302
TPCK.Integr7	,817	
TPCK_ICT4c1	,801	,325
TPCK_ICT4L3	,751	
TPCK_ICT4c3	,722	
TPCK_ICT4L5	,634	
TPCK_ICT4L1	,631	,378
TPCK_ICT4L2	,593	,522
TPCK.K_ICT2		,783
TPCK.Self_ICT2		,778
TPCK.K_ICT3		,756
TPCK.Self_ICT3		,756
TPCK.Self_ICT1		,747
TPCK.Freq_ICT1		,720
TPCK.K_ICT1		,696

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 3 iterations.

Item-Total Statistics

F1 : α= .976 (19), 48.36% var.	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
TPCK.Integr1	55,11	213,356	,867	,974
TPCK.Integr2	55,11	212,273	,877	,974
TPCK.Integr3	55,12	212,083	,876	,974
TPCK.Integr4	55,12	213,668	,848	,974
TPCK.Integr5	55,00	212,332	,856	,974
TPCK.Integr6	55,06	213,989	,857	,974
TPCK.Integr7	54,74	214,195	,805	,975
TPCK_ICT4c1	55,04	213,738	,843	,974
TPCK_ICT4c2	54,90	213,183	,853	,974
TPCK_ICT4c3	54,96	217,805	,733	,975
TPCK_ICT4L1	55,08	217,601	,690	,976
TPCK_ICT4L2	55,10	217,519	,697	,976
TPCK_ICT4L3	54,71	215,893	,757	,975
TPCK_ICT4L4	55,00	213,404	,857	,974
TPCK_ICT4L5	55,07	219,041	,664	,976
TPCK_ICT4p1	54,99	212,486	,843	,974
TPCK_ICT4p2	55,01	212,457	,849	,974
TPCK_ICT4p3	54,86	213,356	,831	,974
TPCK_ICT4p4	54,97	212,953	,852	,974

Item-Total Statistics

F2 : α= .886 (7), 19.785% var.	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
TPCK.Freq_ICT1	20,77	17,742	,677	,870
TPCK.Self_ICT1	20,70	17,583	,689	,869
TPCK.Self_ICT2	19,91	18,200	,705	,867
TPCK.Self_ICT3	20,06	18,215	,635	,875
TPCK.K_ICT1	20,04	19,023	,611	,878
TPCK.K_ICT2	20,09	18,255	,712	,866
TPCK.K_ICT3	20,64	17,774	,722	,864

EFA post questionnaire

b- Knowledge of technology
(PT 2 quest: TK)
Reliability
Run reliability on **section** (Chronbach's α= .907).
All factors, 19 items, α= .907

Found 3 factors explaining 58.337% variance (each factor with reliability α>= .82). Considering the original sources for the questionnaire. Factors are in line with original sources as for items included.

(d) **Higher order/level digital applications and software** α= .886 (8): 24,068% variance
SFW.7-13; INT.4
multimedia software (e.g. Hyperstudio), concept mapping tools (e.g. Kidspiration, C-map), electronic publishing tools (e.g. Publisher, FrontPage), programming languages, modelling and simulations (e.g. Model-it, Stagecast), tools for bibliographic research online (e.g. Scholar),

Item-Total Statistics

α= .907	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
B_K_SFW1	50,24	113,408	,576	,903
B_K_SFW2	51,34	110,304	,541	,903
B_K_SFW3	51,41	108,051	,660	,900
B_K_SFW4	51,86	107,332	,567	,903
B_K_SFW5	50,56	111,728	,558	,903
B_K_HDW1	51,74	113,109	,351	,909
B_K_INT1	50,05	116,428	,422	,906
B_K_INT2	50,11	114,777	,466	,905
B_K_INT3	50,04	116,148	,452	,905
B_K_INT4	51,78	105,117	,614	,901
B_K_INT5	51,65	109,765	,500	,904
B_K_SFW6	52,30	107,249	,618	,901
B_K_SFW7	52,87	111,706	,589	,902
B_K_SFW8	51,60	105,692	,660	,899
B_K_SFW9	52,76	108,611	,622	,901
B_K_SFW10	52,96	110,732	,635	,901
B_K_SFW11	52,87	110,549	,592	,902
B_K_SFW12	52,83	109,112	,637	,900
B_K_SFW13	53,03	111,433	,610	,901

(e) ***Lower order/level / information gathering/production* applications and software** α= .818 (8): 18,338% variance
SFW 1-6; INT.5; HDW1 (weak: without .827)
Office suite (word, excel, PowerPoint), Paint, MovieMaker, databases, platforms for remote collaboration (e.g. wiki, forums), interactive whiteboard

(f) **Common internet application / software** α= .845 (3): 15,931% variance
INT 1-3
Email system, internet browsers (e.g. Chrome), internet search engines (e.g. Google)

Notes: internet application /software remains constant as factor, from PRE (α= .82) to POST (α= .85).
Higher order level loses HDW1 to lower order level but gains from it INT 5.

Rotated Component Matrix[a]

	Component 1	2	3
B_K_SFW1		,578	,559
B_K_SFW2	,195	,676	,136
B_K_SFW3	,284	,721	,188
B_K_SFW4	,218	,735	
B_K_SFW5	,105	,620	,414
B_K_HDW1	,224	,389	
B_K_INT1		,127	,838
B_K_INT2	,111	,187	,829
B_K_INT3		,147	,892
B_K_INT4	,543	,308	,270
B_K_INT5	,271	,451	,228
B_K_SFW6	,478	,517	
B_K_SFW7	,714	,295	
B_K_SFW8	,489	,407	,322
B_K_SFW9	,724	,231	,129
B_K_SFW10	,718	,284	
B_K_SFW11	,757	,203	
B_K_SFW12	,819	,116	,175
B_K_SFW13	,826	,131	

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 5 iterations.

Item-Total Statistics

F1 – α = .886 (8), 24% var.	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
B_K_INT4	13,06	25,380	,591	,884
B_K_SFW7	14,15	27,985	,659	,873
B_K_SFW8	12,88	26,070	,604	,880
B_K_SFW9	14,04	26,502	,677	,870
B_K_SFW10	14,25	27,985	,665	,873
B_K_SFW11	14,14	27,264	,674	,871
B_K_SFW12	14,11	26,172	,767	,861
B_K_SFW13	14,32	27,569	,735	,867

Item-Total Statistics

F2: α = .818 (8), 18% var.	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
B_K_SFW1	21,19	24,449	,591	,796
B_K_SFW2	22,30	22,778	,561	,793
B_K_SFW3	22,36	21,858	,675	,777
B_K_SFW4	22,78	20,977	,614	,785
B_K_SFW5	21,51	23,488	,588	,792
B_K_HDW1	22,70	24,272	,334	,827
B_K_INT5	22,59	22,906	,470	,807
B_K_SFW6	23,25	22,153	,552	,795

Item-Total Statistics

F 3: α = .845 (3), 14% variance	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
B_K_INT1	8,98	1,563	,644	,849
B_K_INT2	8,99	1,393	,715	,784
B_K_INT3	8,93	1,528	,790	,719

EFA –b Frequency of use of technology: access

(PT 3 quest: Freq TK) α= .808 (18):

Analysed as a descriptive measure of the access to technologies. It is observed through the lens of the 3 factors of previous section, to gather more background information that could contribute to the knowledge of use of technologies. When in doubt, for different items in section 2 than in section 1, used original sources' classification.

Factors:

(e) **Lower order/ level / information gathering/ production applications and software** (FREQ.SFW.1-5; FREQ.SFW.14; INT 4): Office suite (word, excel, Powerpoint), Paint, MovieMaker, using educational CD; tools for bibliographic research online (e.g. Google scholar);

(f) **Higher order/ level applications and software** (FREQ._SFW.7-12; INT 5): multimedia software (e.g. Hyperstudio), concept mapping tools (e.g. Kidspiration, C-map), electronic publishing tools (e.g. Publisher, FrontPage), programming languages, modelling and simulations (e.g. Model-it, Stagecast); platforms for remote collaboration (e.g. wiki, forum), databases

(g) **Common internet applications** (FREQ._INT 1, 6): email system, surfing the internet

(h) **Leisure use of technologies** (FREQ._PERS.1-2), as gaming apps (e.g. Solitaire) and social tools (e.g. Twitter).

Note: overall reliability seems slightly increased. Still weak Pers.1, but other items stronger than in PRE. New weak points: INT 4, 6.

Item-Total Statistics

α= .808 (18):	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
B_Freq_Pers1	42,67	62,387	,195	,811
B_Freq_Pers2	45,35	58,955	,329	,804
B_Freq_SFW1	43,06	61,381	,339	,802
B_Freq_SFW2	44,89	58,145	,404	,798
B_Freq_SFW3	44,72	55,402	,587	,785
B_Freq_SFW4	45,43	57,699	,562	,788
B_Freq_SFW5	43,97	58,708	,422	,797
B_Freq_INT1	42,76	63,260	,248	,806
B_Freq_INT6	42,37	65,664	,106	,810
B_Freq_INT4	43,53	58,063	,306	,809
B_Freq_INT5	44,96	56,754	,373	,803
B_Freq_SFW9	45,69	57,653	,511	,791
B_Freq_SFW7	45,93	59,887	,547	,792
B_Freq_SFW10	46,07	61,944	,443	,799
B_Freq_SFW8	45,27	56,714	,564	,787
B_Freq_SFW11	46,07	62,208	,460	,799
B_Freq_SFW12	45,98	61,388	,458	,797
B_Freq_SFW14	45,52	59,380	,416	,797

EFA – b - Contextual support
(PT 4 quest: Context) α= .914 (21):
Analysis of Part 6. Support, α= .914 (21)
Exploratory Factor analysis gives 5 factors with different reliabilities. Factors are composed very differently from pre-questionnaire. Considering PRE questionnaire factors, run reliability of those – as – is, on the POST questionnaire. Reliability of those factors seems solid.
It is decided to use the PRE-factors on the POST questionnaire as well.
University's active role in supporting students: α= .886 (9).

UNIdiscuss 1,2; UNIdesign1-4; UNIfeedb; ENCOUR5; UNIcoll

- in my university courses we discuss the challenges of integrating digital technology in education;
- in my university courses we discuss experiences about the use of digital technologies in teaching;
- in my university courses I receive sufficient help in designing lessons that integrate digital technology;
- in my university courses we receive help to use digital technology when developing educational materials;
- in my university courses I receive a great help in developing ICT-rich lessons and projects;
- in my university courses there are enough occasions for me to test different ways of using digital technology in the classroom;
- in my university courses I receive sufficient feedback about the use of digital technology in my lesson design;
- in my university courses I am encouraged to gain experience in using digital technology in a classroom;
- in my university courses there are enough occasions for me to work together with other students on digital technology use in education.

d) **surrounding concrete encouragement:** α= .784 (8).

ENCOUR1-4, DiscussPeers, UNIex1,3, UNIthink

- many teachers encourage me to integrate computers in my lessons;
- my professors encourage me to integrate computers in my lessons;
- my colleagues encourage me to integrate computers in my lessons;
- my dear ones encourage me to integrate computers in my lessons;
- I often talk about using digital technology with my fellow students;
- there are professors in my university who use computers in teaching and learning;
- in my university courses the potential of digital technology use in education is demonstrated concretely;
- my university program caused me to think more deeply about how technology could change my teaching.

e) **equipment and use**: α= .839 (4).

UNIaccess; UNItechnical; UNIinfractr; UNIex2

- a variety of computer software is available for use in my university;

- the technical support in my university is adequate;
- the technical infrastructure in my university is adequate;
- in my university courses I see good examples of digital technology practice that inspire me to use them in my teaching too.

Item-Total Statistics

α= .914 (21)	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
B_Sup_ENCOUR1	68.18	119.222	.495	.912
B_Sup_ENCOUR2	67.90	119.967	.535	.911
B_Sup_ENCOUR3	68.42	121.561	.393	.914
B_Sup_ENCOUR4	68.79	120.189	.423	.914
B_Sup_discussPeers	68.58	120.325	.415	.914
B_Sup_UNIex1	67.39	124.494	.368	.914
B_Sup_UNIthink	67.65	123.423	.425	.913
B_Sup_UNIaccess	68.30	116.568	.653	.908
B_Sup_UNItechnical	68.51	118.211	.559	.910
B_Sup_UNIinfrastr	68.60	117.495	.579	.910
B_Sup_UNIex2	68.46	114.269	.708	.907
B_Sup_UNIex3	68.42	116.071	.666	.908
B_Sup_UNIdiscuss1	68.23	121.489	.450	.913
B_Sup_UNIdesign1	68.41	116.968	.677	.908
B_Sup_UNIdesign2	68.32	117.801	.652	.908
B_Sup_UNIdesign3	68.57	116.830	.677	.908
B_Sup_UNIcoll	68.24	117.655	.605	.909
B_Sup_UNIdiscuss2	68.39	118.776	.595	.910
B_Sup_UNIdesign4	68.59	117.967	.593	.909
B_Sup_ENCOUR5	68.23	119.547	.581	.910
B_Sup_UNIfeedb	68.58	118.224	.608	.909

Rotated Component Matrix[a]

	Component			
	1	2	3	4
B_Sup_UNIdesign4	.770			
B_Sup_UNIdiscuss2	.769			
B_Sup_UNIcoll	.713			
B_Sup_UNIfeedb	.709			
B_Sup_ENCOUR5	.679			
B_Sup_UNIdesign3	.659			
B_Sup_UNIdesign2	.566			.478
B_Sup_UNIdesign1	.539			.457
B_Sup_UNIex3	.484	.436		
B_Sup_UNItechnical		.862		
B_Sup_UNIinfrastr		.831		
B_Sup_UNIaccess	.341	.613		
B_Sup_UNIex2	.478	.523		.330
B_Sup_ENCOUR3			.829	
B_Sup_ENCOUR4			.806	
B_Sup_ENCOUR1			.646	.333
B_Sup_discussPeers			.605	
B_Sup_UNIthink				.739
B_Sup_UNIex1				.662
B_Sup_ENCOUR2			.478	.550
B_Sup_UNIdiscuss1	.392			.498

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 6 iterations.

EFA –b - Attitudes towards Technologies

(PT 5 Quest: ATT)

Too many factors to run reliability as if it was only one scale (α= .676 (37).

It's possible it is measuring multiple things, different ones, so that's why it comes out low.

Running EFA on all the items, eigenvalue >1, comes out 7 factors. Factors are composed very differently from pre-questionnaire. Considering PRE questionnaire factors, run reliability of those – as – is, on the POST questionnaire. Reliability of those factors seems solid.

It is decided to use the PRE-factors on the POST questionnaire as well.

Item-Total Statistics

F1 post complex, emotive α= .919 (15)	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
B_Att_comf	53.2881	82.063	.769	.909
B_Att_like	52.9322	84.302	.680	.912
B_Att_easy	53.3763	82.855	.626	.914
B_Att_easy2	53.6237	82.127	.652	.913
B_Att_ICTp1	53.3119	83.406	.682	.912
B_Att_Ktofix	53.5119	84.530	.544	.917
B_Att_hardstop	54.2847	89.470	.333	.922
B_Att_tenseR	53.0678	83.737	.686	.912
B_Att_irkR	53.2000	81.950	.677	.912
B_Att_frustrR	53.0068	84.136	.662	.913
B_Att_upsetR	52.8780	83.563	.696	.912
B_Att_noKtofixR	53.7153	85.164	.529	.917
B_Att_ICTp2R	53.2746	83.016	.662	.912
B_Att_ICTp4R	53.0983	85.021	.575	.915
B_Att_difficultR	53.2339	83.785	.671	.912

d) Complex factor: Emotive signposts

If considered all together, all positive, "Positive attitudes" [Comf, like, easy, easy2, ICTp1, KtoFix, hardstop, (-)Tense, (-)irk, (-)frustr, (-)upset, (-)noKtofix, (-)ICTp2, (-)ICTp4, (-)difficult**]** α= .919 (15)

i. Emotive barriers, stress α= .885 (8)

Tense, irk, frustr, upset, noKtofix, ICTp2, ICTp4, difficult

- □ Working with the computer makes me feel tense and uncomfortable;
- □ Working with a computer makes me nervous;
- □ Using a computer is very frustrating;
- □ I am upset when I think of trying to use a computer;
- □ If something goes wrong I will not know how to fix it;
- □ The use of computer in teaching and learning stresses me out;
- □ The use of computers in teaching and learning scares me;
- □ Computers are difficult to use.

ii. **Emotive enablers, comfort** α= .852 (7)

Comf, like, easy, easy2, ICTp1, KtoFix, hardstop (weak, without .861)

- □ I feel comfortable with working with a computer;
- □ I like using the computer;
- □ I find it easy to use computers;
- □ I think computers are very easy to use;
- □ I feel comfortable with the idea of computer as a tool in teaching and learning;
- □ Whenever I need help om using the computer I know where to find proper assistance (manuals, tutorials, instructions, experts);
- □ Whenever I start using a new ICT software, I find it hard to stop.

e) **ICT impact on teaching and learning** α= .911 (16)

ICTpTeachQL 1-4; ICTpLearn 1, 3, 4; ICTp 5-9; ICTpALLb, ICTpCitizen, worthy, exciting

- the quality of my teaching will improve with the use of my PC;
- the computer will change the way I teach;
- if there was a computer in my classroom it would help me being a better teacher;
- the computer helps teacher to teach in more effective ways;
- the computer will change the way students learn in my classes;
- computers can help accommodate different learning styles;
- the computer helps students learn because it allows them to express their thinking in better and different ways;
- the computer is a valuable tool for teachers;
- The computer could enhance remedial instruction;
- the computer helps students understand concepts in more effective ways;
- computers could stimulate creativity in students;
- computers could help students improve their writing;
- all students should have an opportunity to learn about computers at school;
- it is important for students to learn about computers in order to be informed citizens;
- knowing how to use a computer is a worthwhile skill;
- the use of computer as a learning tool excites me.

c. **lack of worth of ICT** α= .733 (5)

ICTp3, ICTpLearn 2, 5 ; ICTpNoUse; noDiff

- the idea of using a computer in teaching and learning makes me sceptical;
- the computer is not conducive to student learning because it is not easy to use;
- the computer is not conducive to good teaching because it creates technical problems;
- I can't think of any way that I will use computers in my career;
- I can do what the computer can do equally as well.

Item-Total Statistics

F1b post, comfort α= .852 (7)	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
B_Att_like	21.36	18.123	.694	.821
B_Att_hardstop	22.72	20.137	.385	.861
B_Att_easy	21.81	17.437	.624	.830
B_Att_comf	21.72	17.391	.743	.813
B_Att_easy2	22.05	16.816	.693	.819
B_Att_Ktofix	21.95	18.088	.548	.842
B_Att_ICTp1	21.75	18.163	.626	.829

Item-Total Statistics

F1a post, stress α= .885 (8)	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
B_Att_tense	14.49	24.688	.700	.866
B_Att_irk	14.37	23.505	.714	.865
B_Att_frustr	14.56	24.954	.683	.868
B_Att_upset	14.69	24.559	.727	.864
B_Att_noKtofix	13.85	25.837	.498	.887
B_Att_ICTp2	14.29	24.369	.675	.869
B_Att_ICTp4	14.47	25.280	.606	.876
B_Att_difficult	14.34	25.086	.649	.871

Item-Total Statistics				
F2 post, impact α= .911 (16)	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
B_Att_ICTpTeachQL1	58.96	62.569	.651	.904
B_Att_ICTpTeachQL2	59.10	62.343	.624	.905
B_Att_ICTpTeachQL3	59.22	62.352	.602	.906
B_Att_ICTpTeachQL4	59.06	62.483	.682	.903
B_Att_ICTpLearn1	59.11	62.645	.672	.903
B_Att_ICTpLearn3	58.78	64.141	.658	.904
B_Att_ICTpLearn4	59.00	63.332	.643	.904
B_Att_ICTp5	58.58	64.392	.640	.905
B_Att_ICTp6	58.86	64.262	.632	.905
B_Att_ICTp7	59.03	63.677	.596	.906
B_Att_ICTp8	58.84	63.193	.609	.905
B_Att_ICTp9	59.39	63.910	.453	.912
B_Att_ICTpALLb	58.45	64.637	.616	.905
B_Att_ICTpCitizen	58.62	64.539	.583	.906
B_Att_worthy	58.29	66.054	.507	.908
B_Att_exciting	59.25	64.403	.461	.911

Item-Total Statistics				
F3 post, lack of worth α= .733 (5)	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
B_Att_ICTp3	8.08	5.436	.565	.658
B_Att_ICTpLearn2	8.29	5.929	.620	.642
B_Att_ICTpLearn5	8.00	5.724	.580	.652
B_Att_ICTpNoUse	8.50	6.257	.567	.664
B_Att_NoDiff	7.63	7.310	.197	.793

EFA – b Self-Efficacy
(PT 6 Quest: self-conf)
Reliability overall: α = .868 (13), weakest are USE 2 (α= .915) and USE 3 (α= .898)
Running EFA on all the items, eigenvalue >1, comes out 2 factors. The second factor is slightly more populated than in the PRE questionnaire and its reliability is α= .689 (4). For consistency reasons, it is decided to use original factor 1 as only factor.

Note: use pre factors, only one item is really different, and Cronbach's a would move from .895 to .896

Item-Total Statistics

F1: α = .868 (13)	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
B_Self_selectSFW	45.31	38.028	.598	.855
B_Self_DesignICTact	45.22	37.791	.674	.851
B_Self_USE1	45.03	39.441	.548	.858
B_Self_USE2	44.83	41.536	.231	.878
B_Self_USE3	45.52	40.084	.299	.877
B_Self_USE4	44.62	40.735	.436	.864
B_Self_USE5	45.15	39.587	.376	.870
B_Self_DIGIMAT1	45.26	37.358	.705	.849
B_Self_DIGIMAT2	45.23	37.624	.735	.848
B_Self_DIGIMAT3	45.17	38.325	.627	.854
B_Self_DIGIMAT4	45.08	38.303	.680	.852
B_Self_adaptSFW	45.08	38.641	.676	.852
B_Self_ICT4content_criticThink	44.97	38.451	.661	.852

b) **Perceived self-efficacy in integrating ICT: 49.437% of variance**
SelectSFW, DesignICTact, USE1, 5; DIGIMAT 1-4; adaptSFW, ICT4content_criticThink.
α= .896 (10)

- I can select appropriate software to use in my lessons;
- I can design learning activities for my students, using ICT;
- I can use the Internet in my lessons;
- I can use Interactive Whiteboards in my teaching;
- I can assess the use of digital learning materials;
- I can use digital learning materials in my teaching;
- I can customize activities with the computer in different circumstances;
- I can use digital technologies to present concepts;
- I can adapt the use of digital technologies I am learning about, to different teaching activities;
- I can think critically about how to use technologies in my teaching;

Rotated Component Matrix[a]

	Component	
	1	2
B_Self_DIGIMAT2	.808	
B_Self_DIGIMAT3	.793	
B_Self_DesignICTact	.792	
B_Self_selectSFW	.771	
B_Self_adaptSFW	.738	
B_Self_DIGIMAT1	.738	
B_Self_ICT4content_criticThink	.723	
B_Self_DIGIMAT4	.714	
B_Self_USE5	.483	
B_Self_USE2		.864
B_Self_USE1	.364	.650
B_Self_USE4		.614
B_Self_USE3		.592

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 3 iterations.

Item-Total Statistics

F1 α = .896 (9)	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
B_Self_selectSFW	29.80	22.894	.660	.885
B_Self_DesignICTact	29.71	22.901	.716	.880
B_Self_USE5	29.64	24.283	.402	.909
B_Self_DIGIMAT1	29.76	22.778	.716	.880
B_Self_DIGIMAT2	29.72	22.878	.766	.877
B_Self_DIGIMAT3	29.66	23.052	.706	.881
B_Self_DIGIMAT4	29.57	23.610	.678	.883
B_Self_adaptSFW	29.58	23.754	.694	.883
B_Self_ICT4content_criticThink	29.47	23.568	.682	.883

Item-Total Statistics

F2: α = .648 (4)	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
B_Self_USE1	11.65	3.911	.486	.550
B_Self_USE2	11.45	3.298	.517	.512
B_Self_USE3	12.14	3.433	.354	.655
B_Self_USE4	11.24	4.235	.406	.601

EFA – b TPCK
(PT 7 Quest: TPCK)
Section reliability: α=.959 (26)

Original source talks about 2 factors: F1 = knowledge of teaching with curriculum based ICT; F2 = knowledge of technology (TPACK core).
Considering multiple EFA runs and theoretical premises, the 2 factor section seems sensible. It results almost identical to original sources.

Note: factors remain the same, only ICT4L 1 moves from 2nd to 1st factor, but still related to 2nd too. Decided to go with the PRE factors, as proven reliable.

b) **TPCK in practice** explains 35.69% variance. α=.959 (18)
Integr1-7; ICT4c1-3; ICT4L 2-5; ICT4p 1-4
- I can use curriculum-based strategies that combine curriculum, technologies, and teaching approaches to support student learning;
- I can use curriculum-based technologies that enhance the teaching approaches in my curriculum area(s) to support student learning;
- I can use curriculum-based technologies that support student understanding, thinking and learning in my curriculum area(s);
- I can adapt the use of particular technologies to different teaching activities in my curriculum area(s);
- I can use technology to improve what I teach, how I teach and what students learn;
- I can adapt the contents to achieve the objectives of teaching with the help of technology;
- I can integrate technology into teaching my lessons;
- I can use technologies that are specific to my curriculum area(s);
- I can use technologies to support student learning in my curriculum area(s);
- I can identify specific topics in my curriculum area(s) where technologies support the learning of the topic;
- I know how to explain the specifics of using different technologies to students;
- I know about technologies that I can use for students learning in my curriculum area(s);
- I can choose technologies that fit with learning goals in my curriculum area(s);
- I can envision how students reason when using technology in my curriculum area(s);
- I know how to design classroom activities that integrate technologies as learning tools;
- I know how to design technology-based classroom activities that motivate students;
- I know how to use technologies to differentiate instruction;
- I know how to design technology-based classroom activities to support student collaboration.

c) **TPCK awareness** explains 16.24% of variance. α=.904 (8)
Freq ICT1; K_ICT1-3; Self_ICT1-3; ICT4L1
- I explore new technologies frequently;
- I know about a lot of different technological tools;
- I have the technical skills needed to use different technologies;
- My knowledge of new technologies is up-to-date;
- I know how to solve my own technical problems;

- I learn to use new technologies easily;
- I have confidence in my ability to work with different technologies;
- I know how to use technology to assess student work.

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
B_TPCK.K_ICT1	87.33	201.723	.628	.958
B_TPCK.K_ICT2	87.44	201.361	.628	.958
B_TPCK.Self_ICT1	88.15	197.352	.607	.959
B_TPCK.K_ICT3	87.85	198.772	.640	.958
B_TPCK.Self_ICT2	87.47	199.210	.618	.958
B_TPCK.Freq_ICT1	88.26	198.998	.582	.959
B_TPCK.Self_ICT3	87.60	198.928	.631	.958
B_TPCK_ICT4L1	87.93	200.838	.601	.958
B_TPCK_ICT4L2	87.83	200.350	.670	.958
B_TPCK_ICT4L3	87.46	201.509	.656	.958
B_TPCK_ICT4L4	87.64	199.591	.748	.957
B_TPCK_ICT4c1	87.69	200.268	.699	.957
B_TPCK_ICT4c2	87.63	199.881	.717	.957
B_TPCK_ICT4c3	87.69	201.035	.683	.958
B_TPCK_ICT4L5	87.91	201.939	.601	.958
B_TPCK_ICT4p1	87.56	201.167	.732	.957
B_TPCK_ICT4p2	87.59	200.629	.742	.957
B_TPCK_ICT4p3	87.62	201.476	.658	.958
B_TPCK_ICT4p4	87.60	199.895	.721	.957
B_TPCK.Integr1	87.68	199.817	.721	.957
B_TPCK.Integr2	87.84	198.230	.770	.957
B_TPCK.Integr3	87.85	199.132	.731	.957
B_TPCK.Integr4	87.70	199.629	.738	.957
B_TPCK.Integr5	87.82	199.654	.750	.957
B_TPCK.Integr6	87.72	199.495	.764	.957
B_TPCK.Integr7	87.45	201.215	.703	.957

Rotated Component Matrix[a]

	Component	
	1	2
B_TPCK.Integr4	.795	
B_TPCK.Integr6	.790	
B_TPCK_ICT4c2	.786	
B_TPCK_ICT4L4	.784	
B_TPCK.Integr2	.783	
B_TPCK.Integr5	.775	
B_TPCK.Integr3	.771	
B_TPCK_ICT4c1	.759	
B_TPCK_ICT4p2	.732	.303
B_TPCK.Integr1	.723	
B_TPCK_ICT4p4	.722	
B_TPCK_ICT4p1	.716	.306
B_TPCK_ICT4p3	.706	
B_TPCK.Integr7	.678	.315
B_TPCK_ICT4c3	.668	
B_TPCK_ICT4L5	.624	
B_TPCK_ICT4L3	.595	.343
B_TPCK_ICT4L2	.546	.437
B_TPCK_ICT4L1	.533	.339
B_TPCK.Self_ICT2		.824
B_TPCK.K_ICT2		.819
B_TPCK.Self_ICT1		.781
B_TPCK.K_ICT1		.767
B_TPCK.K_ICT3		.765
B_TPCK.Self_ICT3		.731
B_TPCK.Freq_ICT1		.657

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 3 iterations.

Item-Total Statistics				
F1 post α=.959 (18)	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
B_TPCK_ICT4L2	60.17	98.274	.627	.958
B_TPCK_ICT4L3	59.80	98.540	.650	.958
B_TPCK_ICT4L4	59.98	96.574	.788	.956
B_TPCK_ICT4c1	60.03	96.969	.742	.956
B_TPCK_ICT4c2	59.97	96.574	.770	.956
B_TPCK_ICT4c3	60.03	97.956	.696	.957
B_TPCK_ICT4L5	60.26	98.372	.626	.958
B_TPCK_ICT4p1	59.90	98.047	.747	.956
B_TPCK_ICT4p2	59.94	97.554	.766	.956
B_TPCK_ICT4p3	59.96	97.916	.695	.957
B_TPCK_ICT4p4	59.94	97.013	.744	.956
B_TPCK.Integr1	60.03	96.936	.745	.956
B_TPCK.Integr2	60.18	95.789	.797	.955
B_TPCK.Integr3	60.20	96.297	.765	.956
B_TPCK.Integr4	60.05	96.552	.781	.956
B_TPCK.Integr5	60.16	96.741	.781	.956
B_TPCK.Integr6	60.06	96.538	.802	.955
B_TPCK.Integr7	59.79	98.104	.715	.957

Item-Total Statistics				
F2 post . α=.904 (8)	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
B_TPCK_ICT4L1	24.35	26.441	.471	.910
B_TPCK.Freq_ICT1	24.68	23.999	.655	.895
B_TPCK.K_ICT1	23.75	25.023	.731	.889
B_TPCK.K_ICT2	23.86	24.643	.763	.886
B_TPCK.K_ICT3	24.28	23.716	.751	.886
B_TPCK.Self_ICT1	24.57	22.877	.739	.888
B_TPCK.Self_ICT2	23.89	23.622	.762	.885
B_TPCK.Self_ICT3	24.02	24.013	.716	.889