TPCK and Initial Teacher Education: Insights on the Development Of Pedagogical Reasoning in TPCK-Based Instructional Design (ID) Practices

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Abstract: In the last decades, the Technological Pedagogical Conent Knowledge (TPCK - Mishra & Koehler, 2006; Angeli & Valanides, 2009) came to the forefront of educational research, as framework to define teachers' knowledge in acknowledgement also of the growing role of technologies in educational practices. Moreover, teachers' pedagogical reasoning (Loughran et al., 2016), along with tacit beliefs, is proving to be a powerful doorway to link (student) teachers' pedagogical choices and technologies' intended uses (Heitink et al., 2016). This paper reports an ongoing research aimed at investigating TPCK-related instructional design procedures (IDP - Messina, De Rossi et al., 2016) offered by three initial teacher education programs (Cyprus, Italy, The Netherlands), in relation to the development of student teachers' pedagogical reasoning (STPR). Pre/post questionnaires, focused interviews, and observation protocols will be used to gather data while participants are engaged in TPCK-based ID tasks, in a mixed method design. Expected findings will hopefully let see a connection between the use of TPCK-based IDP and STPR development. Finally, we will try to identify some communal structural elements among the different procedures, in the perspective of the future definition of an internationally shared IDP to support STPR development, to the service of policy makers and initial teacher educators.

Theoretical Premises

The complex practice of teaching takes place in an ill-structured, dynamic environment, hinging upon complex cognitive and strategic skills (Mishra & Koehler, 2006). Historically, teaching knowledge has been deeply linked first to the content knowledge, then to a pedagogical competence, till an integrated form of knowledge was suggested by Shulman (1986), under the name of Pedagogical Content Knowledge (PCK). This concept later acknowledged explicitly the ever-growing role of technologies in the educational discourse, thus becoming Technological Pedagogical Content Knowledge (TPACK or TPCK, Mishra & Koehler, 2006; Angeli, Valanides, 2009). This can be defined as the "*teachers' concurrent and interdependent content, general pedagogy, and technology understanding"* (Harris & Hofer 2009, p. 100), that hinges also upon the single forms of interaction between each knowledge base with the others, and/or upon the transformative knowledge resulting from these interactions (Angeli & Valanides, 2009), according to the different perspectives. Multiple are the interpretations of the TP(A)CK framework: already in 2008, for example, Cox observed around a hundred significantly different definitions of TP(A)CK constructs. In the attempt to clarify the TP(A)CK framework, usually researchers have focused on either of its components: Technology Knowledge – TK (e.g. Lee & Tsai, 2010; Figg & Jaipal, 2012; Wang, 2008; Yeh et al., 2014); Pedagogical Knowledge – PK (e.g. Harris & Hofer, 2011; Chai, Koh & Tsai, 2013; Benton-Borghi, 2015; Kramarski & Michalski, 2015); and/or Content Knowledge – CK (e.g. Doering et al., 2009; Guerrero, 2010; Harris & Hofer, 2011). Moreover, recent on the TP(A)CK framework suggests further consideration of context and learners understanding, as well as teacher's beliefs and practical experience (Angeli, Valanides, 2009; Chai, Koh & Tsai, 2013).
This very last dimension, related to teachers' beliefs and thinking strategies, figures indeed as a powerful filter to teaching practices, especially when technology comes into play (Ertmer, 2005; Ertmer & Ottenbreit-Leftwich, 2010; Voogt et al., 2012). In particular, Teachers' Pedagogical Reasoning (TPR) is seen as key in establishing a connection between pedagogical strategies and technologies' intended uses (Heitink et al, 2016), having a deep connection with TPCK since its formulation by Shulman (1987) as *pedagogical reasoning and action.*
Later in the years, many studies explored TPR within different educational contexts (see Loughran et al., 2016). Among the others, Starkey (2010) operated on Shulman's model considering modern digital resources for

teaching, and Niess and Gillow-Wiles (2017) intended TPR as Technological Pedagogical Reasoning, declaring once more the importance of technologies in this concept. Moreover, Starkey (2010) operating on Shulman's model, found that student teachers' decisions were based on learning theories pre-dating the digital era. Thus, she proposed the *Model of teacher pedagogical reasoning and action for the digital age* (Starkey, 2010), which consists of five major steps: (a) comprehension of subject matter (thought as substantive knowledge and syntactic knowledge); (b) enabling connections (selection of appropriate resources/methods to enable students to actively make connections between their prior knowledge and the developing subject matter knowledge, as well as among the people engaged in the process; transformation of existing knowledge into teachable content; and personalisation of learning): (c) teaching and learning; (d) reflection; and (e) new comprehension (Starkey, 2010; Loughran et al., 2016).

Researches on TPR and its connections with teaching practices show often a gap between teachers' saying and doing (So & Kim, 2009; Heitink et al., 2016), with important implications for actual technology integration, which is supported by teachers' informed choices about technologies' affordances and contextual characteristics (Britten & Cassady, 2005; Heitink et al., 2016). Crucial as TPR could be in linking (personal) theories and practices, there is still an essential need for teachers to learn how to explicitly reason about their practice (Heitink et al., 2016) and an ideal setting to foster this understanding is to be found in teachers' education (Loughran et al., 2016).

Various authors suggest providing teachers in education with authentic examples of technology-enhanced teaching practices to reflect upon, enabling them to share their reasoning and problematize practice, discussing examples in critical perspective (Ertmer & Ottenbreit-Leftwich, 2010; Heitink et al., 2016; Loughran et al., 2016). Among the several strategies documented in literature, student teachers' involvement in ICT enhanced lesson design is found to be an effective conduit for their TP(A)CK development, as TP(A)CK itself can be seen like repurposing technology through teachers' design efforts (Chai, Koh & Tsai, 2013). On this line, for example, Baran and Uygun (2016) observe that the design process offers meaningful exposure to technology integration in educational contexts, as it shows almost explicitly how technology, pedagogy, content, and contextual factors mutually reinforce/constrain each other. Once again, literature on the theme is wide and significant, reported also in works like McKenney and colleagues' (McKenney & Reeves, 2012; McKenney et al., 2015), who outline an ecological framework to investigate research on ID; or the one by Baran and Uygun (2016) examining design-based learning approaches enacted in international research to put TPACK in action, with the identification of eight design principles broadly adopted to foster TPACK development.

Notwithstanding the broad literature on the development of technology-enhanced instructional design (ID) proficiency in student teachers, there does not seem to be yet a wide agreement on a practical procedure that could help educators and learners in linking the theoretical framework of TPCK and the teaching practice of technology-enhanced ID, acknowledging the role of TPR in the process.

Present Research

Considering said theoretical background, we want to present the outline of an ongoing research which investigates the instructional design procedures (IDP) offered in initial teacher education and connected to the TP(A)CK perspective (Mishra & Koehler, 2006; Angeli & Valanides, 2009; Messina, De Rossi et al., 2016), within the development of student teachers' pedagogical reasoning. The main question this research moves from is*: How does a TPCK-based instructional design procedure (IDP) relate to student teachers' pedagogical reasoning (STPR)?*

In answering this question the study investigates (a) STPR during TPCK-based instructional design tasks supported by IDP; and (b) student teachers' pedagogical beliefs about ICT in instructional design, as tacit part of their pedagogical reasoning.

The final goal would be to identify structural commonalities among the different TPCK-based IDPs and their elements, that could foster engagement of STPR in initial teacher education programs.

Participants

In order to answer the research question and fulfil the objective, this research engages preservice teachers attending university level courses dealing with TPCK-related ID proficiency. The selected sample ($n_{tot} = 300$) considers student teachers enrolled in ITT programs in three universities, respectively in Italy, Cyprus and The Netherlands. Participants were selected according to the following sequential criteria: (a) belonging to the European countries with comparable teacher education curricula, within higher education institutions; (b) teacher education contexts already familiar with the TPCK framework; and (c) presence of courses engaging student teachers in ID tasks with the support of a TPCK-based IDP.

Methods and Instruments

The design of the research within each case study (Italian, Cypriot, and Dutch) revolves around the design process supported by IDP, in which participants are actively engaged twice. It figures as mixed method (Creswell, 2013), combining the use of both quantitative and qualitative means for data collection: a pre-/post – questionnaire, semi-structured interviews and observation protocols.

The first instrument for data collection is a pre-/post – questionnaire based on the Schmidt and colleagues' validated survey on the topic (2009), adapted to the contexts considering other theoretical references (Papanastasiou & Angeli, 2008; Messina, De Rossi et al., 2016; Yilmaz-Ozden, Mouza & Shinas, 2016). It is aimed at gathering general information about the sample, with a specific part dedicated at investigating participants' pedagogical reasoning, considering in particular ICT-related beliefs, seen as the tacit part of STPR. It thus comprises 7 sections: (a) participants' demographic information (closed questions); (b) student teachers' knowledge of technology tools; (c) student teachers' frequency of use for personal purposes; (d) student teachers' attitudes toward technology; (e) student teachers' self confidence in using technology in teaching and learning; (f) educational context and support; and (g) student teachers' self-assessment of their willingness of integrating technologies in ID. Sections (b) to (g) are all in the form of 5 – points Likert scale items. Data collected through this questionnaire will be processed with SPSS software for data analysis. Given the different contexts in which it will be implemented, the questionnaire has been translated in Dutch, Greek and Italian with the help of certified translators and the review of experts on the field, each version undergoing a pilot test, and it is administered at the beginning and at the end of the study to the entire populations (n_{tot}= 300).

On the qualitative side, semi-structured, focused interviews (Cohen, Manion & Morrison, 2000) are carried out to investigate participants pedagogical reasoning about their design choices, broadening the information gathered with questionnaires. They deal with three aspects of the design experience: (a) the contextual IDP and its elements, with the aim of identifying possible strategies of familiarization or mastery in the use of the instrument, possible misconceptions, etc.; (b) perceived decisional turning points in said IDP, always regarding the reasoning steps described by Starkey (2010) as mentioned earlier; (c) technological – related beliefs, to widen questionnaire based information. Interviews take place at the end of the study, engaging a quota sample of the populations, and are carried out in English, with the support of trained native – speaker researchers for the germane contexts.

Finally, the third means of data collection is through participant observation with an observation protocol, aimed at gathering information on participants' interactions and reasoning aloud during ID tasks. Participants engaged in this observation are again a quota sample of the different populations and, as for the interviews, this part is carried out in English, with the support of native – speaker researchers for the germane contexts.
Data collected through these qualitative strategies will be analysed with ATLAS.TI software for discourse analysis.

Expected findings

This research is in progress, at this moment in the phase of completing the first case study in Cyprus before moving to the Dutch one, and, finally, to the Italian case. Even if it is too early to discuss data, we believe that this study will let see a connection between the use of the ID procedure for technologically enhanced lessons, and the development of student teachers' pedagogical reasoning. Moreover, we would expect to observe some modifications in participants' professional reasoning and ICT-related pedagogical beliefs, hopefully in a more mature consideration and awareness of the role of ICT in ID. Finally, we hope to be able to identify some structural elements shared by the different procedures, which could help a future definition of an internationally shared IDP to support STPR development, to the service of policy makers and (initial) teacher educators.

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