ON THE USE OF E-TPCK FOR SITUATED TEACHER PROFESSIONAL DEVELOPMENT

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ABSTRACT

The authors herein justify the need for e-TPCK, an adaptive e-learning system for teaching in-service teachers how to teach with technology. Outlining the instructional design process involved and the adaptivity feature of e-TPCK, it is explained how the system promotes and measures the development of teachers' Technological Pedagogical Content Knowledge (TPCK). Considering the novel alternative of the system to more traditional professional development approaches, the authors conclude with the argument for employing e-TPCK in real classroom settings in a situated way.

KEYWORDS

e-TPCK, instructional design, adaptive learning, technology-enhanced practice, situated professional development

1. INTRODUCTION

Despite the massive investments to integrate technology in education, teachers still appear unprepared to engagingly link technology to their pedagogy and competently use it in their daily practice. These limitations have been attributed to several barriers, including teachers' inadequate technical skills and limited understanding of the pedagogical affordances of technology (Fu, 2013). To secure sustained technology-enhanced classroom practice, it has been consistently suggested that substantial efforts focus on teachers' professional development. However, the literature reveals that training programs often prove ineffective due to insufficient emphasis placed on the pedagogy behind technology use (Kirschner & Davis, 2003).

Scholarly work over the last decade has focused on developing theoretical frameworks to ground research in the area of teaching with technology; extending Shulman's (1987) Pedagogical Content Knowledge, researchers have proposed Technological Pedagogical Content Knowledge (TPCK), a new body of knowledge that teachers need to possess to effectively teach with technology. There are two theoretical conceptualizations of TPCK, the integrative view (Mishra & Koehler, 2006), and the transformative view (Angeli & Valanides, 2005). Research has indicated that measuring empirical evidence of TPCK development appears more reliable following the latter (Graham, 2011), which is the view we adopt here and which addresses TPCK as a unique body of knowledge conceptualized in terms of: technology knowledge, pedagogical knowledge, content knowledge, knowledge of learners and knowledge of context. In brief, TPCK is described as the ways knowledge about technology, pedagogy, content, learners and context form an understanding of how subject-matter topics can be taught with technology, for specific learners in specific contexts, to maximize learning outcomes (Angeli, Valanides, Mavroudi, Christodoulou, & Georgiou, 2015).

Acknowledging the struggle of traditional training programs to engage teachers in purposeful integration of technology, TPCK has been proposed as an appropriate framework for the design of professional development (Niess, 2011). This is a crucial step toward successful integration of technology into teaching; yet, in view of research evidence suggesting the importance of contextualized and personalized training programs according to the teachers' needs (Kopcha, 2012), we further emphasize the need for e-TPCK, an adaptive and interactive e-learning system for promoting teachers' TPCK (Angeli et al., 2015). Based on an instructional design approach, e-TPCK could prove highly effective in situated professional development.

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2. E-TPCK AND ADAPTIVE INSTRUCTIONAL DESIGN

Designed following a Design-Based Research approach, the e-TPCK aspires to promote teachers' ongoing TPCK development by personalizing the content of technology-infused design scenarios; each of these scenarios is structured to guide teachers through a series of instructional design decisions about how to teach a particular topic using specific digital tools (Angeli et al., 2015). The system is inspired by socio-cultural theories of learning and capitalizes on the concepts of scaffolding and self-regulated learning. Aiming to reduce cognitive load, adaptive scaffolding of various forms is implemented according to the users' knowledge, understanding and choices; as the users attain competence fading of scaffolding becomes available upon request, enabling them to regulate their experience and engage in task definition, goal setting and planning, monitoring and control of their learning, and reaction/reflection (ibid). Below, the instructional design principles and the need for the adaptivity feature of e-TPCK are explained.

2.1 Instructional Design and Development of TPCK

Being student-centered and goals-oriented, the instructional design (ID) process is characterized by procedures for systematically developing education and training materials (Reiser & Dempsey, 2012). In this respect, instruction is viewed as a system emphasizing the key role of all components in the process and their interaction. The literature is saturated with different ID models, with Gagne's taxonomy (Gagne & Briggs, 1974) being perhaps the most popular in the field because of its clear distinction between abstract and concrete definitions of learning. Despite their variety, traditional ID models include the phases of 'ADDIE', an acronym for: Analysis (identification of a problem and goal setting), Design (articulate measurable objectives), Development (preparation of instructional materials), Implementation (delivery of instruction) and Evaluation (formative/summative evaluation and revision of instruction) (Reiser & Dempsey, 2012). Scholars in the field have also considered the content, objectives and learners in selecting the media in the ID process, yet many addressed these in a rather generic and de-contextualized way (Angeli & Valanides, 2005).

Identifying major differences between typical ID and teachers' actual instructional decision-making, recent ID models emphasize the need to identify specific content but also analyze learners' characteristics and contextual elements (Angeli & Valanides, 2005; Dick, Carey, & Carey, 2005). Capitalizing on the fact that teachers' design decisions are influenced by their personal beliefs and classroom experiences and that their content knowledge interacts with their knowledge of curriculum, learners, pedagogy and context, Angeli & Valanides have associated instructional design with the development of TPCK and proposed Technology Mapping as the core of an ID model which is situated in teachers' actual practice (Angeli & Valanides, 2005, 2013). This approach to instructional design is depicted on the structure of the technology-infused learning design scenarios of the e-TPCK system. Specifically, each scenario includes the following phases: 1) Rationale of topic selection; 2) Brief subject-matter content description; 3) Learning objectives (lower-order objectives, higher-order objectives, ICT-related objectives); 4) Learning methodology/model; 5) Sequence of classroom activities: a) Attract student interest, b) Identify students' initial understandings or misconceptions, c) Destabilization of initial perceptions – cognitive conflict, d) Student engagement in knowledge construction, e) Application of new knowledge, f) Revision and comparison with initial perceptions.

As reflected on the structure of the design scenarios in e-TPCK, teachers' development of TPCK is measured in terms of distinct instructional design competencies (Angeli & Valanides, 2013). The first competency is related to the identification of topics to teach with technology in ways that signify the added value of ICT tools. As a next step, teachers are required to consider the tool affordances to identify representations for transforming the content to be taught into forms that are comprehensible to students and difficult to support by traditional means. Still considering the tool affordances, teachers must then identify teaching strategies that are difficult or impossible to implement by other means. Next, they need to select tools with inherent affordances to support the previous two steps. Finally, teachers need to design and infuse technology-enhanced learning activities in the classroom.

2.2 Adaptivity and Adaptive Learning Design

The importance of engaging teachers in systematic design of the learning scenarios in their classroom, especially in the new media era, cannot be stressed enough. The adaptivity of the e-TPCK system seeks to further empower teachers' design thinking providing personalized e-learning. The operational principle of

any adaptive system is that an effective instruction process should consider individual learners' characteristics and profiles (Towle & Halm, 2005).

Adaptation may be system-controlled, with the system adapting to perceived learner profiles, or user-controlled, with the system being adaptable by the learners. In the case of e-TPCK, adaptation and instructional control is shared between the teacher user and the system (Angeli et al., 2015). More specifically, there are three different categories of design scenarios: completed scenarios, semi-completed scenarios and new scenarios that teachers need to complete from scratch. There are four different types – levels of semi-completed scenarios, according to the amount of scaffolding provided to the users to complete the design. The higher the scenario level the more phases (of those outlined in Section 2.1) are missing and intended for teachers to complete. It is made clear that when logged-in to the system, the teacher is asked to choose the ICT tool involved in the learning activity and the difficulty level of a design scenario. Scaffolding is provided based on the teacher's Likert-scale rating of the cognitive effort they experience, after specific phases of a scenario are completed. According to their rating, the system asks if a less or more demanding design scenario is preferred or if the user wants to continue with the same scenario. Therefore, the adaptive learning strategy employed here consists of the adaption rules, i.e. the rules that assign shared control between the system and the user, the adaptation parameters, i.e. the user's perceived cognitive load, choice of ICT tools and the difficulty level of the scenario, and the adaptation methods, i.e. tailoring content, learning flow and sequencing of activities (ibid).

Adaptive scaffolding to foster self-regulated learning is also implemented through prompts to teachers for progress monitoring and reflection on their competency, the task or the context. Activity monitoring and reflection are also facilitated through the learning analytics incorporated in the e-TPCK system. In addition, adaptive feedback is assigned to encourage metacognitive reaction and assist with the completion of the semi-completed design scenarios and the development of new design scenarios.

The above remarks emphasize the fact that the e-TPCK system capitalizes on adaptivity to develop teachers' TPCK, facilitating their instructional design thinking. Moreover, it is further argued that the adaptive process and the reflection it engages teachers in could improve their own understanding of adaptive instruction. Teachers being designers of adaptive technology-enhanced learning would be an important step in addressing students' divergent needs more effectively and optimizing their learning experiences. The design principles of adaptive learning and the Technology Mapping to develop TPCK incorporated in the foundations of e-TPCK, could prove valuable in training teachers in the design of adaptive instruction.

3. SITUATED USE IN REAL CLASSROOM SETTINGS

The previous discussion on adaptive instructional design highlights the novelty of the e-TPCK system compared to more traditional approaches to professional development which, as noted earlier, often fail to engage teachers in ICT-enhanced pedagogical reasoning and practice. The system adaptivity, a feature not usually available in typical training programs, is central in accommodating teachers' diverse needs, knowledge, abilities and experiences toward the development of their TPCK. Moreover, even though the e-TPCK objectives and structure apply to both pre-service and in-service teacher education, in this paper we see great value in the situated use of the system in real classroom settings. Besides, research evidence strongly indicates the potential of situated professional development to promote sustainable classroom practice with technology (Kopcha, 2012).

What is key to stress is that the structure of the e-TPCK design scenarios guides teachers to identify and purposefully employ technology affordances within the context of an authentic design task directly related to a specific subject-matter topic and the curriculum. This way, lack of connection to actual classroom practice, which has been repeatedly acknowledged as a major drawback of traditional professional development, is not a concern. Then, the design process is context-sensitive with teachers being invited to consider their real contextual conditions (related to their classroom, school, system) and their students' profiles when defining the learning objectives and planning the activities in any scenario, corroborating the situated use of the system. Additionally, contrary to stand-alone workshop training for technology integration or even mentor-based professional development, the e-learning platform provides ubiquitous access to teachers allowing them to resort to e-TPCK at any preferred point in their daily professional routine. Beyond the convenience aspect, this flexibility is argued to encourage reflection and intended involvement in the instructional design.

In proposing e-TPCK as a novel professional development system, the 'default' socio-cultural aspect in any situated learning setting is another point to acknowledge. Drawing upon research on professional development on technology integration (Mouza, 2006), but also the literature on professional learning communities (Vescio, Ross, & Adams, 2008), we acknowledge the importance of collective participation and interaction toward the establishment of a collaborative work culture. To this end, a 'social networking tools' area is integrated in the e-TPCK system where teachers can discuss and exchange ideas with others synchronously or asynchronously. Moreover, any semi-completed or new design scenario fully completed by a user and approved by the instructional designer/tutor, is added in the design scenarios database for sharing. In a more systematic approach, enabling sharing of teachers' different knowledge, competencies and experiences, the e-TPCK system could facilitate the development of communities of practice. In such communities, especially when fostered within the same school unit, teachers' development of TPCK would be further promoted, eventually leading to a sustainable integration culture.

4. CONCLUSION

The purpose of this work-in-progress paper was to discuss the instructional design process of the e-TPCK e-learning system toward the development of teachers' TPCK in the context of professional development, considering the adaptivity feature of the system. Thus, the novelty of the system compared to more traditional professional development programs is underlined, while the contribution of the paper lies in the argument for the appropriate and effective use of e-TPCK in real classroom settings in a situated way, especially in relation to the buildup of communities of practice.

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