Preparing preservice teachers for self-regulated learning in the context of technological pedagogical content knowledge

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Abstract

The present study investigated effects of two hypermedia environments on 95 preservice university teachers' self-regulated learning (SRL) in the context of technological pedagogical content knowledge (TPCK): hypermedia with metacognitive instruction (HYP + META) and without (HYP). The study combined online reflections with self-report measures to assess SRL processes. Results showed that exposure to metacognitive support using the IMPROVE self-questioning method may enhance preservice teachers' ability to reflect on and regulate their learning processes. This, in turn, can develop their TPCK, both as learners (comprehension skills) and as teachers (design skills). Further analysis indicated high correlations within SRL measures (self-reports, online reflections) and between SRL and TPCK tasks. Implications are discussed for teacher training in SRL-integrated TPCK contexts.
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1. Introduction

Research indicates that, despite the many efforts, researchers and educators have invested over the years in preparing teachers in the educational uses of technology, teachers continue to lack the skills and knowledge needed to be able to teach successfully with technology (Angeli & Valanides, 2005, 2008a, 2008b; Niess, 2005). Researchers propose that the lack of theoretical and conceptual frameworks to inform and guide the integration of technology into teaching and learning is a major weakness in the educational technology literature (Angeli & Valanides, 2005, 2008a; Margerum-Lays & Marx, 2003; Mishra & Koehler, 2006; Niess, 2005). These researchers advocate that teaching with technology requires the development of theoretical "pedagogical content knowledge" (PCK; Shulman, 1986, 1987) as it extends into the domain of teaching with

technology, termed "technological pedagogical content knowledge" (TPCK).

Researchers have also begun to direct increasing attention to individual self-regulation in learning as a means for enhancing academic outcomes (Pintrich, 2000; Zimmerman, 2000). Self-regulated learners are good strategy users. They plan, set goals, select strategies, organize, self monitor, and self-evaluate at various points during the process of acquisition (Pintrich, 2000; Schraw, Crippen, & Hartley, 2006). To enhance understanding of developing teachers' knowledge in the field of educational technology, the present study suggests a model for integrating self-regulated learning (SRL) into preservice teachers' preparation of TPCK in hypermedia environment. In line with this claim, our study raises the main question: How can teacher preparation program for SRL guides preservice teachers' development of a TPCK and SRL for changing teaching and learning in classroom?

Prior to describing the present exploratory study's design, there is a brief overview of TPCK, SRL, and the presentation of a supporting model for integrating SRL into preservice teachers' preparation of TPCK as these concepts were utilized in the present study.

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1.1. Technological pedagogical content knowledge

Shulman (1986, 1987) described teachers' PCK as the ways content, pedagogy, and knowledge of learners are blended into understanding about how particular topics to be taught are represented and adapted to learners in order to engage students extensively in tasks that require comprehension. Several conceptions of how to extend PCK into the context of teaching with technology exist in the literature under different labeling schemes, such as ''PCK of educational technology'' (Margerum-Lays & Marx, 2003), ''TPCK'' alone (Koehler, Mishra, & Yahya, 2007; Mishra & Koehler, 2006; Niess, 2005), and Information and Communication Technology TPCK (ICT-TPCK) as a strand of TPCK (Angeli & Valanides, 2005, 2008a, 2008b). In the present article, the acronym TPCK will be used henceforth and will be related to the ICT-TPCK framework introduced by Angeli and Valanides (2005, 2008a, 2008b).

Angeli and Valanides (2008a, p. 5) described TPCK as integrated knowledge in which components should not be acquired separately and then put together somehow, but rather should be developed concurrently via technology-rich lessons designed ''toward transformation of these contributing knowledge bases into something new''. At the heart of the TPCK conceptualization is the view that technology is not a vehicle that simply delivers information; rather, it facilitates acquisition of cognitive tools that amplify students' higher-order cognitive processing (e.g., critical thinking, problem-solving) and extends the thinking processes of their users (Jacobson & Archodidou, 2000; Jonassen, 2000; Linn & Muilenburg, 1996). To achieve this objective, teachers should know that successful implementation of technology involves a considerable change in teachers' roles. The traditional teacher-centered role of acting as a ''source of knowledge'' should be replaced by learner-centered learning and by the role of initiating and coaching students' inquiries and problem-solving while using the cognitive tools offered by technology (Hannafin & Land, 1997; White & Horwitz, 1987).

1.2. TPCK in a hypermedia context

In the present study, TPCK was investigated within a particular type of technology-based learning environment, a hypermedia context. Hypermedia is a technology environment whose characteristics are conducive to developing teaching and learning knowledge as recommended by TPCK researchers (Angeli & Valanides, 2005, 2008a, 2008b; Mishra & Koehler, 2006; Niess, 2005). As a nonlinear environment, hypermedia provides new possibilities for teaching about the structure of domain knowledge by using representations or delivery media (e.g., video clips, sound bite graphics, hypertexts, animations). Hypermedia is considered a powerful cognitive tool that transforms abstract content into more concrete or realistic forms of knowledge, and, as such, it may facilitate conceptual knowledge development (Azevedo, 2005; Dillon & Jobst, 2005; Jacobson & Archodidou, 2000; Jonassen, 2000; Lajoie & Azevedo, 2006; Shapiro, 1999;

Winters, Green, & Costich, 2008). Furthermore, hypermedia allows for learner-centered learning through navigating in the environment, namely, for deciding what to learn, how to learn, whether one understands the material, when to change learning plans and strategies, and when to increase efforts (Azevedo, Cromley, & Seibert, 2004; Azevedo & Jacobson, 2008; Winters et al., 2008).

Based on evidence from empirical investigations, learners' simultaneous development of TPCK components is a complex process that demands various capabilities (Angeli & Valanides, 2005, 2008a, 2008b; Mishra & Koehler, 2006; Niess, 2005). Although hypermedia can readily provide multiple tools and opportunities to manipulate them in the pedagogical uses, it is often up to the teacher to: (a) identify which task is suitable for teaching in technology; (b) determine which tool is most helpful to infuse in teaching/learning and why; (c) find when and how to use it; and (d) select the optimal pedagogical method to support that choice. Such careful, considered engagement by teachers is indicative of self-regulated learning (Pintrich, 2000; Schraw et al., 2006; Zimmerman, 2000). Thus, the theoretical framework of SRL and its role in developing TPCK in the hypermedia context are highlighted in the following sections.

1.3. Integrating SRL into the TPCK hypermedia context

In recent years, the role of SRL in education has elicited much interest. Research has focused on SRL skills as a means to attain successful learning. There are many different SRL models that propose different constructs, but they do share some basic assumptions about learning and regulation (Butler & Winne, 1995; Pintrich, 2000; Schraw et al., 2006; Zimmerman, 2000, 2008). Specifically, SRL is an active process referring to ''self-generated thoughts, feelings, and actions that are planned and cyclically adapted to the attainment of personal goals'' (Zimmerman, 2000, p. 14). SRL involves a combination of cognitive, metacognitive, and motivational processes used in a learning context (Pintrich, 2000; Zimmerman, 2000). Cognitive processes refer to information-processing strategies like rehearsal, elaboration, and organization. Metacognitive processes refer to monitoring and control of cognitive skills, usually involving the planning, monitoring, and evaluation of one's own learning in terms of achieving personal goals. The motivational processes refer to students' willingness to learn and to attain academic self-efficacy. Finally, the learning context refers to learning conditions such as the type of task or technology.

Educators and researchers believe (Leelawong et al., 2002; Putnam & Borko, 2000) that preparing to teach in a self-directed open-ended technology environment like hypermedia is tied to preservice teachers' own self-regulation abilities in two ways. First, preservice teachers must be able to achieve SRL for themselves (the learner's perspective in SRL), that is, be themselves self-regulated learners. Second, preservice teachers must be able to understand how to help their students achieve SRL (the teacher's perspective in SRL). Each SRL perspective can be developed through TPCK tasks focusing on