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The development and validation of an instrument for assessing college students' perceptions of faculty knowledge in technology-supported class environments

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ABSTRACT

Research in the area of educational technology has argued that the technological pedagogical content knowledge of faculty is crucial to addressing the challenge of teaching in higher education in the digital age, which is characterized by the common use of instructional technology in college classrooms and the ubiquitous presence of computing on college campuses. We developed and validated an instrument for assessing students' perceptions of faculty knowledge (SPFK) in technology-supported classroom environments. A total of 50 items in 4 constructs with 9 items in subject matter knowledge (SMK), 11 items in technological knowledge (TK), 6 items in knowledge of students' understanding (KSU), and 24 items in technological pedagogical content knowledge (TPACK) were developed for the instrument. The construct validity of this instrument was examined through confirmatory factor analysis. After checking the construct structure of the instrument, the multidimensional version of the rating scale model (MRSM) was used to analyze item response data. Results showed that after the elimination of item 17, the 49-item instrument for assessing college students' perceptions of faculty knowledge was validated in the current study. The reliability for each subscale of this instrument was found to be satisfactory when analyzing data with the MRSM model. Discussion of results and recommendations for future research are also provided.

1. Introduction

Technology is well on its way to becoming ubiquitous in education, and there is increasing evidence that technology, when properly infused and integrated into teaching and learning, has a significant positive effect on student learning (Hicks, 2006; Schrum et al., 2007). However, one of the most significant stumbling blocks to the use and integration of technology in both teaching and learning environments at all educational levels has been the lack of training for teachers and faculty (Bennett, 2004; Ertmer, 2003). Research has shown that college teachers tend to be well-equipped with respect to content knowledge in their specific disciplinary areas, but often lack pedagogical skills (Clark & Hollingsworth, 2002; Major & Palmer, 2006). Jang (2011) proposed that developing college teachers' pedagogical content knowledge (PCK) is the key to promote effective teaching for college faculty. However, the challenge of teaching in college classrooms is compounded by the common use of instructional technology in such classrooms and the ubiquitous presence of computing on college campuses. Vogel and Klassen (2001) highlighted important issues and trends of teaching in higher education in technology-supported learning, indicating the importance of increasing the range of faculty's instructional methods with the support of technology. Viewing teachers' knowledge as including rich relationships among content, pedagogy, and technology also has significant implications for teaching in higher education. The widespread presence of computing and instructional technology on college campuses makes the issue of how to teach with technology in higher education a prominent one (Bates & Poole, 2003). Online learning and online courses are so common in higher education that they have often been seen as the preferred solution to efficient learning and teaching in the digital age. Well-equipped technology-enhanced classrooms are often proposed as a panacea for educational problems associated with rapid social change and fast-

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moving technology development (Cuban, 2001). What is often neglected is that it is not the availability of the technology which is important, but rather how the technology is used.

Therefore, we argue that PCK alone cannot adequately address the issue of the pedagogical development of college faculty. However, a newly emerging theoretical framework, technological pedagogical content knowledge (TPCK; Koehler & Mishra, 2008; Mishra & Koehler, 2006), renamed TPACK for the sake of easy memorization and designating an integrated description of the three kinds of knowledge addressed—technology, pedagogy, and content—should be able to address the challenge of teaching in the digital age (Thompson & Mishra, 2007–2008). TPACK highlights the complex interplay between technology, pedagogy, and content, and provides insights into effective teaching using technology; thus, it may be used to frame and guide both professional development projects for college faculty and research aimed at improving teaching practice in higher education. While first generation TPACK work focused on defining and conceptualizing the framework's constructs, more recent work has focused on using the framework in both research and development projects. However, most TPACK research and development projects have measured the level of teachers' self-assessed TPACK, revealing the processes and interactions related to technology-supported teaching, or facilitating the design of professional teacher development (Archambault & Crippen, 2009; Lee & Tsai, 2010; Schmidt et al., 2009). Little research has investigated just how students respond to their teachers' instruction in technology-supported class environments, especially considering that students themselves may be the best experts on their own views and school experiences. Learning environment research emphasizes a student cognition paradigm and maintains that the manner in which students perceive and react to their learning tasks and classroom instruction can have a more significant impact on student outcomes than the observed quality of teaching behaviors (Knight & Waxman, 1991; Waxman, 1991; Waxman & Huang, 1997; Wittrock, 1986). Students ultimately respond most significantly to what they perceive as important.

Thus, we developed and validated an instrument for assessing students' perceptions of college teachers' knowledge in technology-supported classroom environments. The purpose of this study was to describe the development and validation of the instrument. It is expected that with this rigorous and scientifically based instrument, responses and perceptions of students can be further recognized to improve the effectiveness of teaching with technology in higher education.

This study is organized as follows. First, we provided the shift of theoretical framework from pedagogical content knowledge (PCK) to technological pedagogical content knowledge (TPACK), and stressed the importance of student cognition paradigm, which emphasizes the ways in which students perceive and react to their learning tasks. Then, the procedure of survey instrument development was described and how each of the four constructs was developed. After checking the construct structure of the instrument, the multidimensional version of the rating scale model (MRSM) was used to analyze item response data. Following the discussion of the validity and reliability of the developed instrument and the related literature, we addressed several limitations and implications of this study and lastly provided recommendations for future research.

2. Theoretical framework

2.1. From PCK to TPACK

Shulman (1986) proposed an in-depth view of what teachers must know in order to teach, highlighting that teachers must be able to transform subject matter content to provide learners access to that knowledge. Teachers must also integrate knowledge of both content and pedagogy into pedagogical content knowledge (PCK). Shulman (1986, 1987) further elaborated that PCK relates to the transformation of subject matter for teaching that occurs as the teacher interprets the subject matter, finds multiple ways to represent the content, and adapts instructional materials to students' prior knowledge and alternative conceptions. However, because technology has become an integral component in schools at all levels, Niess (2005, p. 510) argued that teachers must also develop "an overarching conception of their subject matter with respect to technology and what it means to teach with technology—technology PCK (TPCK)".

Building on Shulman's idea of PCK, Mishra and Koehler (2006) added technology to PCK, and described technological pedagogical content knowledge (TPCK) as the interweaving of technology, pedagogy, and content. Renamed TPACK, this framework represents the combination of subject content, pedagogical, and technological knowledge, to "form an integrated whole, a 'Total PACKage'" (Thompson & Mishra, 2007–2008, p. 38). TPACK focuses on the complex interactions between a teacher's knowledge of content (CK), pedagogy (PK), and technology (TK). It recognizes the unique and interactive roles that content, technology, and pedagogy play in authentic teaching and learning environments, and suggests that we consider "an emergent form of knowledge" that goes beyond content, technology, and pedagogy considered in isolation (Mishra & Koehler, 2006, p. 1028). In contrast to the simple view of technology as merely a tool isolated in a generic manner and unconnected with knowledge of the subject matter and pedagogy, TPACK, according to Mishra and Koehler (2006, 2009), emphasizes interactions among content, pedagogy, and technology.

Recently, with more clearly defined and interpreted TPACK constructs (Koehler & Mishra, 2008; Mishra & Koehler, 2006), there has been an upsurge of research utilizing the TPACK framework. For example, Jang and Chen (2010) proposed a transformative model for preservice science teachers to help them develop technologically based pedagogical methods and strategies of integrating subject matter knowledge into their science lessons, advancing these methods and strategies using TPACK methodology.

Niess (2005) argued that, with high-availability technology in classrooms, PCK would gradually be replaced by the concept of TPACK. Several recent studies have used the TPACK framework to thoroughly examine both inservice (Graham et al., 2009) and preservice teachers' development in TPACK (Albion, Jamieson-Proctor, & Finger, 2010; Graham, Cox, & Velasquez, 2009; Schmidt et al., 2009) and their efforts to use technology in their teaching in several domain areas such as math (Niess, 2005, 2006), science (Graham et al., 2009), and social studies (Hammond & Manfra, 2009). Angeli and Valanides (2009) developed an argument describing TPACK as a distinct body of assessable knowledge and proposed ICT-TPCK as a strand of TPCK based on five domains: ICT, content, pedagogy, learners, and context. They then developed a combination of self, peer, and expert assessment to investigate preservice teachers' ICT-TPCK competence in two design tasks. Arguing that the World Wide Web is a specific case of technology, Lee and Tsai (2010) developed a TPCK-W (Web) instrument to measure 558 Taiwanese teachers' self-efficacy in terms of their TPCK-W. Correlations were found between self-efficacy and positive attitudes toward web-based instruction, and older and more experienced teachers were found to have lower levels of self-efficacy with respect to TPCK-W. The Schmidt et al. survey (2009) was designed for repeated use by preservice teachers in college teacher education programs as they