Computers & Education 55 (2010) 1744–1751

Contents lists available at ScienceDirect

Computers & Education

journal homepage: www.elsevier.com/locate/compedu

Integrating the interactive whiteboard and peer coaching to develop the TPACK of secondary science teachers

Syh-Jong Jang*

Chung-Yuan Christian University, Graduate School of Education, 200 Chung-Pei Road, Chung-Li 32023, Taiwan, ROC

ARTICLE INFO

Article history:
Received 11 June 2010
Received in revised form
24 July 2010
Accepted 26 July 2010

Keywords:
Computer-mediated communication
Pedagogical issues
Teaching/learning strategies

ABSTRACT

Many studies related to the use of interactive whiteboards (IWBs) in educational settings have shown that IWB technology can result in enhanced presentations and in the development of student motivation and student performance. However, the relationship between the use of IWBs and Technological Pedagogical Content and Knowledge (TPACK) by teachers is yet to be fully investigated and understood. The purpose of this study was to integrate IWB technology and peer coaching to develop the TPACK of secondary science teachers in real classrooms. An IWB-based peer coaching model was developed. Participants of this study included four in-service science teachers. The sources of data included written assignments, reflective journals and interviews. The results displayed three major findings. First, science teachers used IWBs as instructional tools to share their subject-matter knowledge and to express students' understanding. Second, the IWBs helped the science teachers who encountered teaching difficulties in the traditional classroom better implement their representational repertoires and instructional strategies. Finally, the proposed model of integrating IWBs and peer coaching can develop the TPACK of science teachers. The research implications of this study are provided along with suggestions.

1. Introduction

One criticism of school-based instruction is the use of outdated teaching methods and contents to equip current students for future society (Jang, 2009a). Science teachers in the 21st century need to be equipped with professional teacher knowledge, which has been referred to as Technological Pedagogical Content Knowledge (TPCK). This implies that teachers have the ability to apply technology into their pedagogical strategies and content representations for teaching specific topics to promote students' learning efficiency (Mishra & Koehler, 2006; Niess, 2005). The TPCK framework builds on Shulman's (1986, 1987) construct of Pedagogical Content Knowledge (PCK) to include technological knowledge as situated within content and pedagogical knowledge (Mishra & Koehler, 2006). Furthermore, the TPCK framework not only expresses the importance of technological integration but also introduces the relationships and the complexities between all three basic components of knowledge (technology, pedagogy, and content). However, rather than treating these as separate bodies of knowledge, TPCK is the integration of the development of subject-matter knowledge with that of technology and of teaching and learning knowledge (Jang & Chen, in press; Niess, 2005).

Many studies have been undertaken to investigate the use of interactive whiteboards (IWBs) in classroom environments. They have focused primarily on the use of IWBs in increasing student motivation (Glover, Miller, Averis, & Door, 2007; Hall & Higgins, 2005; Hennessy, Deaney, Ruthven, & Winterbottom, 2007; Higgins, Beauchamp, & Miller, 2007; Schmid, 2008; Slay, Sieborger, & Hodgkinson-Williams, 2008). In 2006, the Ministry of Education in Taiwan provided the impetus to build e-learning environments for secondary and primary schools, and continually set up IWBs as part of the technological facilities. However, some teachers are afraid of changing, and still use the traditional teaching media which they are familiar with. They lack not only the understanding of the technological IWB facilities, but also practice using the related supports of IWBs (Kent, 2006; Smith, Higgins, Wall & Miller, 2005). However, many studies have shown that teachers point out the efficiency, flexibility and versatility of IWBs and the opportunity to access multimedia content, as well as the ability to

* Corresponding author. Tel./fax: +886 3 2656812.
E-mail address: jang@cycu.edu.tw.

0360-1315/$ – see front matter
doi:10.1016/j.compedu.2010.07.020

manage the class more easily by using an IWB (Smith et al., 2005). It seems clear that many teachers have found IWB-supported planning to be an important and highly motivating teaching resource (Gillen, Littleton, Twiner, Staarman, & Mercer, 2008; Holmes, 2009; Loveless, 2003; Warwick & Kershner, 2008).

Individual teachers may encounter some difficulties while applying the new technology. Science teachers should cooperate with others through teamwork instead of working alone (Jang, 2008). Peer coaching provides a community of practice to be defined as a group of individuals who share such commonalities as interests, knowledge, resources, experiences, perspectives, behaviors, language, and practices (Jang, 2009b; Lave & Wenger, 1991). Bowman and McCormick (2000) suggested that through social interaction, active learning evolves and each participant interprets, transforms, and internalizes new knowledge. Within the framework of peer coaching, such collaborative discussions allow individuals to develop their own perspectives and to model strengths for others. Peer coaching can be described as a collegial approach to the analysis of teaching aimed at integrating new skills and strategies in classroom practice (Joyce & Showers, 1995).

Numerous studies related to the use of IWBs in educational settings (particularly in mathematics) have shown that IWB technology can result in enhanced presentations and in the development of student motivation (Glover et al., 2007; Torff & Tirotta, 2010), and student performance (Arcavi, 2003; Lopez, 2010; Sedig & Liang, 2006). However, it would appear that the relationship between the use of IWBs and the TPCK of teachers is yet to be fully investigated and understood, particularly for science teachers (Gillen et al., 2008). Therefore, the purpose of this study was to integrate IWB technology and peer coaching to develop the TPCK of secondary science teachers in real classrooms.

2. Theoretical framework

2.1. Technological pedagogical and content knowledge

TPCK highlights the connections and interactions among content, pedagogy, and technology (Mishra & Koehler, 2006). Koehler, Mishra, and Yahya (2007) stated that TPCK is a situated form of knowledge required for the intelligent use of technology in teaching and learning. Thompson and Mishra (2008) proposed to rename the acronym TPCK as TPACK (pronounced “tee-pack”) for the purpose of making it easier to remember and to form a more integrated whole for the three kinds of knowledge addressed: technology, pedagogy, and content. Furthermore, the complex among the three kinds of knowledge was reframed as TPACK, describing it as the total package required for integrating technology, pedagogy and content knowledge in the design of curriculum and instruction (Niess et al., 2009; Thompson & Mishra, 2008). TPACK represents a new direction in understanding the complex interactions among content, pedagogy and technology that can result in successful integration of technology in the classroom. TPACK is an extension of PCK and is primarily achieved when a teacher knows how technological tools transform pedagogical strategies and content representations for teaching specific topics. Therefore, science teachers reemphasized the importance of these three kinds of knowledge integration so that teachers can attain a whole knowledge system to help students promote their learning.

Koehler et al. (2007) reported on the results of a semester-long investigation of the development of TPACK during a faculty development design seminar, whereby faculty members worked together with master students to develop online courses. A quantitative discourse analysis of 15 weeks of field notes for two of the design teams showed that participants moved from considering technology, pedagogy and content as independent constructs towards a richer conception that emphasized connections among the three knowledge bases. Hence, through the collaboration of science teachers might gain deeper understandings of the complicated relationships between content, pedagogy and technology that functioned in the peer coaching context.

Graham, Burgoyne, Cantrell, Smith, St. Clair, and Harris (2009) also designed a survey to measure in-service science teachers’ TPACK confidence. They developed a pre–post questionnaire which included 31 questions and two open-ended questions to measure in-service teachers’ confidence related only to the four TPACK constructs that involve technology. The results also suggested the instrument was useful in helping the program coordinators to see significant increases in the TPACK confidence of participants over the eight-month duration of the program. However, Graham et al. (2009) focused on quantitative data collection and analysis limited to portraying the context of science teaching and learning. They also neglected to mention that a deep knowledge of science content is also an essential ingredient in the teaching mixture of technology, pedagogy and content knowledge bases.

Angeli and Valanides (2009) proposed five indicators for pre-service teachers to assess TPACK in designing instruction with technology: (a) Identification of topics to be taught with technology in ways that signify the added value of tools, such as topics that students cannot easily comprehend, or topics that teachers face difficulties in teaching effectively in class; (b) Identification of representations for transforming the content to be taught into forms that are comprehensible to learners and difficult to support by traditional means; (c) Identification of teaching strategies, which are difficult or impossible to implement with traditional means; (d) Selection of appropriate computer tools and effective pedagogical uses; and (e) Identification of appropriate strategies to be combined with technology in the classroom, which include any strategies that put the learner at the center of the learning process.

While the five indicators provide related rich examples related to teaching, there are few specific subject examples of students’ background knowledge and the application of teaching strategies. Concrete examples of scientific topics could help to better describe the interaction among all the elements in TPACK.

2.2. Using interactive whiteboards to develop teacher’s TPACK

IWBs are large, touch-sensitive boards that control a computer connected to a digital projector, allow the user to prepare material in advance or construct it in front of a class, quickly retrieve it for display to the whole class when required and manipulate items directly on the display (Kennewell, Tanner, Jones, & Beauchamp, 2008). In related studies, IWBs are considered as tools that enhance teaching and support learning. As a tool to enhance teaching, the use of IWBs supports teachers’ planning and development of resources and allows teachers to model appropriate technology skills for the students. They also improve interactivity and student participation in lessons (Smith et al., 2005). It has also been reported that the efficiency, flexibility and versatility of IWBs as teaching tools allow teachers to support multiple needs within one lesson (Miller & Glover, 2002; Smith et al., 2005).