# Colloquium

## Research trends in technological pedagogical content knowledge (TPACK) research: A review of empirical studies published in selected journals from 2002 to 2011

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### Background and objectives

Nowadays, with the advancements in information and communication technologies, the integration of technology into education has received more and more attentions. Undoubtedly, teachers play a central role in the successful implementation of technology-enhanced instruction (Liaw, 2002). Consequently, teachers have been increasingly expected to be capable to integrate technology into their instruction for innovative teaching. Teachers' "technological pedagogical content knowledge" (TPCK or TPACK) has been recognized as the most crucial influential factor for teachers' successful integration of technology into their instruction (Koehler & Mishra, 2008). TPACK refers to the "body of knowledge that teachers now need for teaching with and about technology in their assigned subject areas and grade levels" (Niess, 2008, p. 224). The conception of TPACK, first appeared as TPCK, builds upon Shulman's (1987) work describing pedagogical content knowledge (PCK) as an integrated and transformed construct of teacher knowledge about pedagogical knowledge (PK) and content knowledge (CK), and has emerged over the last decade (Mishra & Koehler, 2006).

Recently, the importance of TPACK for understanding effective teaching with technology has been advocated (eg, Ferdig, 2006; Niess, 2005). The TPACK framework proposed by Koehler, Mishra, Yahya and Yadav (2004) describes teachers' understanding of the complex interplay between technology, content, and pedagogy. At the core of the TPACK framework, there are three areas of knowledge: CK (ie, knowledge about the subject matter that is to be learned or taught), PK (ie, knowledge about the processes, practices or methods of teaching and learning and knowledge about educational aims, values and purposes) and technology knowledge (ie, knowledge about more commonplace technologies including overhead projectors, blackboards and modern technologies, such as computers, the Internet, interactive whiteboard) (Mishra & Koehler, 2006).

The TPACK framework has been recognized as an important theoretical foundation for technology integration research, and TPACK research in which the TPACK framework is explicitly used in exploring teachers' teaching with technology has been flourishing (eg, Angeli & Valanides, 2009; Baran, Chuang & Thompson, 2011; Mishra & Koehler, 2006; Polly, 2011). The understanding of the status of such emerging research would be helpful for educators and researchers in understanding the current TPACK research progress and choosing appropriate topics for further investigation. Therefore, this study aimed to review empirical TPACK studies published in influential international journals from 2002 to 2011. The research questions of the current study are:

1. What is the status of the TPACK studies published in the selected journals from 2002 to 2011? Is the amount of empirical studies regarding to this topic increasing or decreasing?
2. What sample groups were selected in the empirical TPACK studies published in the selected journals from 2002 to 2011?

3. What subject domains were involved in the empirical TPACK studies published in the selected journals from 2002 to 2011?
4. What research methods were adopted in the empirical TPACK studies published in the selected journals from 2002 to 2011?

## Method

To conduct a systematic review on the TPACK research, the Social Science Citation Index (SSCI) database was used as the literature source for the review in this study. In this study, only the empirical studies that explicitly stated to explore teachers' TPACK were included in the review. When searching in SSCI database, the time period of searching was from 2002 to 2011, and the keywords for the "topic" of SSCI publications were "technological pedagogical content knowledge," "TPCK" and "TPACK." Besides, only journal papers were reviewed in this study; research publications other than journal papers, such as in conference proceedings, unpublished dissertations, books or book chapters, were not included in the review.

To confirm that the selecting papers were empirical studies and related to TPACK research, the paper titles and abstracts of the selected papers were manually and systematically screened. Finally, 24 empirical studies were identified for the review in this study. The *sample groups*, *subject domains*, and *research methods* involved in the selected empirical studies were analyzed in this study.

## Results

*Number of papers published*
Figure 1 shows the number of TPACK papers published from 2002 to 2011. As shown in Figure 1, among the 24 TPACK studies, only 2 of them were published from 2002 to 2006, while 22 of them were published from 2007 to 2011. Moreover, Figure 1 also reveals TPACK research increased at a fast pace from 2009. The results suggest that the TPACK research has received increasing attention form researchers and educators during the past decade.

*Sample groups in the reviewed studies*
Regarding the distribution percentages of the sample groups analyzed from 2002 to 2011, pre-service teacher has the highest ranking (54.2%), followed by high school teacher (20.8%), elementary school teacher (16.7%), and university or college teacher (8%) in sequence (Table 1). As shown in Table 1, preservice teachers were most frequently used as the research sample in both TPACK studies conducted in 2002 to 2006 and those conducted in 2007 to 2011, implying that the TPACK studies tended to be conducted in teacher education contexts. However, it should also be noticed that dramatically increasing studies focusing in-service teachers' (including
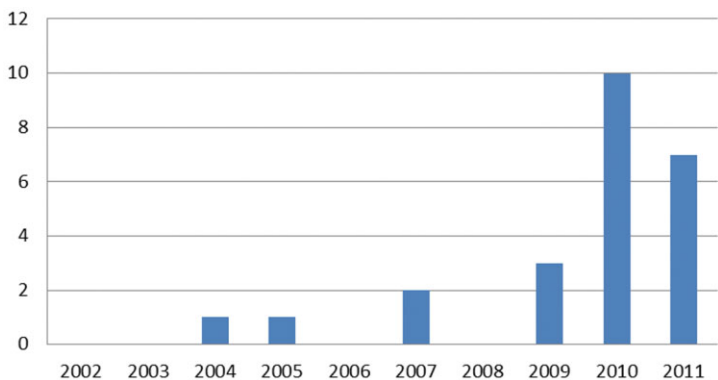


*Figure 1: Number of TPACK studies published from 2002 to 2011*

*Table 1: Sample groups of the TPACK studies published from 2002 to 2011*

|  | Preservice teacher | Elementary school teacher (grades 1–6) | High school teacher (grades 7–12) | University or college teacher |
|---|---|---|---|---|
| 2002–06 | 1 (50%) | 1 (50%) | 0 | 0 |
| 2007–11 | 12 (54.5%) | 3 (13.6%) | 5 (22.7%) | 2 (9.1%) |
| Total | 13 (54.2%) | 4 (16.7%) | 5 (20.8%) | 2 (8%) |

*Table 2: Subject domains in the empirical TPACK studies published from 2002 to 2011*

|  | Science | Math | Social studies | Language | Geography | Not specified |
|---|---|---|---|---|---|---|
| 2002–06 | 0 | 1 (50%) | 0 | 0 | 0 | 1 (50%) |
| 2007–11 | 5 (22.7%) | 2 (9.1%) | 1 (4.5%) | 1 (4.5%) | 1 (4.5%) | 15 (68.2%) |
| Total | 5 (20.8%) | 3 (12.5%) | 1 (4.2%) | 1 (4.2%) | 1 (4.2%) | 16 (66.7%) |

Note: A study might involve more than one subject domain.

*Table 3: Research methods in the TPACK studies published from 2002 to 2011*

|  | Qualitative | Quantitative | Mix method |
|---|---|---|---|
| 2002–06 | 2 (100%) | 0 | 0 |
| 2007–11 | 8 (36.4%) | 11 (50%) | 3 (13.6%) |
| Total | 10 (41.7%) | 11 (45.8%) | 3 (12.5%) |

elementary school, high school and university and college teachers) TPACK were conducted during 2007–10. It suggests that further TPACK research can focus on in-service teachers' TPACK.

*Subject domains involved in the reviewed studies*
Table 2 revealed that, in the period of 2002 to 2011, both teachers' domain-general TPACK and domain-specific TPACK were studied. However, more than half of the empirical TPACK studies (66.7%) focused on teachers' domain-general TPACK, and relatively fewer studies explored teachers' domain-specific TPACK. Moreover, science (20.8%) and mathematics (12.5%) are the two major subject domains that were explored in those domain-specific TPACK studies. It may be because science and mathematics are relatively more abstract to students, and science teachers and math teachers may be more tended to adopt technologies to help students overcome their learning difficulties. Thus, science teachers and mathematics teachers TPACK were comparatively highlighted by educators and researchers. The findings also suggest more studies can be conducted to explore teachers' domain-specific TPACK.

*Research methods adopted*
Table 3 reveals that the most frequently research methods used in the TPACK studies published during 2002 to 2011 is quantitative research methods (45.8%), followed by qualitative research methods (41.7%) and mix methods (12.5%). However, during 2002–06, only qualitative research methods were used in the TPACK studies, while both quantitative research methods and mix methods were also utilized to explore teachers' TPACK in the studies published during 2007–11. It seems that various research methods have been used by education researchers during the last decade.

## Conclusions

This paper reviews the empirical TPACK studies published in SSCI journals from 2002 to 2011. It is found that the number of TPACK studies has significantly increased. In addition, more and more empirical studies on in-service teachers' TPACK as well as on domain-specific TPACK were conducted during 2002 to 2011. Moreover, various research methods have gradually been used in TPACK research during the past 10 years. These findings may provide researchers some possible directions for further TPACK research. Also, these findings may be helpful for teacher educators for designing and planning professional development programs on TPACK.

## Acknowledgment

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