SECI-driven Problem-based Learning for Cultivating Technological Pedagogical Content Knowledge

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Abstract: This design-based research explored how an problem-based learning (PBL) approach guided by the SECI framework (socialization, externalization, combination, internalization)—with the support of collaborative technologies such as wiki—can help in-service teachers cultivate technological pedagogical content knowledge (TPCK). Based on the quantitative and qualitative data, teachers showed an increase in TPCK. While the results are promising, further research in different settings is needed.

Introduction

Teachers must learn to think more deliberately about how to use technology to improve teaching and learning—specifically, to critically choose or even design and configure, learn and apply technologies that will best meet the teaching and learning needs within their context. This knowledge is often referred to as technological pedagogical content knowledge, or TPCK (Mishra & Koehler, 2006). Built on Shulman's (1986) framework, Mishra and Koehler (2006) suggested that good teaching with technology requires a nuanced understanding of the mutually reinforcing relationships between all three knowledge bases (technology, pedagogy and content) taken together to develop appropriate, context specific strategies and practices. In this paper, we report on the first cycle of a design-based research (Edelson, 2002) exploring an approach to help teachers develop such a knowledge-base.

Design Framework

To cultivate TPCK, the basic idea is to create opportunities for teachers to focus on a problem of practice, and then seek ways to critically choose and use technology to address the problem. Despite learning about technology during this process, they also learn "how to learn" about technology and "how to think" about technology that is most appropriate to the situation they are in, particularly to engage students towards intended learning outcomes (Koehler & Mishra, 2005; Tee & Karney, 2010).

Building on this thinking, a problem-based learning approach (Bransford and Steins, 2002) guided by the SECI framework (Tee & Karney, 2010; Nonaka, Toyama, & Byosiere, 2001) – with the support of collaborative technologies such as wiki – was used as a basis for the design of a semester-long course on teaching and learning with technology for in-service teachers. Activities were designed to enable knowledge sharing, construction and utilization through socialization, externalization, combination and internalization. The overall condition, or *ba* as Nonaka calls it, was designed to energize the knowledge sharing and cultivating activities by providing enabling conditions of autonomy, fluctuation and creative chaos, redundancy, requisite variety, and trust and commitment.

In practice, the first 4-week segment was to give students time to identify and define the problems they were facing in real life. The teachers then worked in teams based on the specific problems they chose to own and work on. The second 4-week segment was for the teams to consider different solutions, propose and select a solution. The third 4-week segment was for each group to implement the selected solution in a pilot or full-blown situation, and subject it to further evaluation. The fourth and final 2-week segment was for students to present and discuss the process and outcome of the entire learning cycle. Each class session was used to discuss findings and suggest and justify ways forward. Each group was required to chronicle their on-going experience on a Wikispace page. In addition, they were also requested to write a 2- to 3-page learning reflection every four weeks on what they have learnt during the process.

Discussion of Findings

The discussion will revolve around Group Beemer because they left a more salient data trail. The first research question is: Can iPBL help in-service teachers cultivate TPCK? A self-progress survey initially developed by Schmidt et al (2009) was improvised to address this question. Using repeated measures t-test, overall statistics (mean prior and mean after the course) for the whole class (N=24) showed significant differences ranging from 0.27 to 1.39, and relatively large effect sizes ranging from .73 to 1.75 (Tee & Lee, 2011). The mean differences for Group Beemer (see Table 1) also showed positive progress in the teachers' TPCK.

The second research question is: If yes to the first question, how? If no to the first question, why not? Group Beemer has 5 members (with pseudonyms of B1, B2, B3, B4 and B5). Group Beemer identified a real-world problem revolving around B1's Year 9 students who were struggling with learning Bahasa Malaysia, or

BM (Malay Language). This happens to be the national language, but many of B1's students did not seem very committed to learning the language.

Initially, the teachers blamed the students. Then, through a series of discussions and exploration of different ways to solve the problem, they began to focus more on what they could do as teachers. And towards the mid-semester, the teachers became more focused on using learning activities to help students attain desired depth of understanding. As they progressed through this experience, they came to realize that technology in itself is not likely to improve learning or bad teaching practices. The following reflection by B2 encapsulates their transformation:

> At the beginning we were not very clear about the use of technology basically because we were thinking that technology by itself was an excellent tool to use in teaching, but as the class progressed we realized that we had to focus first on the analysis of our situation and choose the right technology only after doing the whole analysis of the teaching and learning scenario. By learning from the other groups as well, we realized that may be some technological tools that worked excellent with a group of students may not work the same way with others.

Table 1: Summary statistics of teachers' beliefs in using technology for teaching – Group Beemer (N=5).

	Mean prior	Mean after	Mean difference
TK	3.25	3.58	0.33
PK	3.22	3.81	0.59
CK	2.58	3.00	0.42
TCK	2.50	3.25	0.75
TPK	3.15	4.10	0.95
PCK	2.50	3.00	0.50
TPCK	2.58	3.75	1.17

Conclusion

What has happened here, as a precursor to learning to choose and use technology, the SECI-based PBL process had opened up opportunities for the teachers to re-evaluate their teaching practices and to rethink the nature of the subject that they teach, and how technology might play a role to supporting the learning of the subject.

Much of the class was designed with the intention to create a conducive milieu to stimulate SECI, through enabling autonomy, fluctuation and creative chaos, trust and care (Tee & Karney, 2010). Socialization and externalization largely manifested in the form of class discussions, occasional online discussions and out-of-class group discussions. Both externalization and combination can be seen in the wiki-based ebook project and higher-stake presentations at the end of the course. Internalization was stimulated in the implementation and reflections in class, and reflections they were writing for the course. A large part of class time was used to encourage students to present where they were at and more importantly justify their diagnosis of their situation and justify their way forward. While the results are promising, similar research in different settings is needed.

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