Developing Professional Competency in a CSCL Environment for Teamwork: Two TPACK Case Studies of Teachers as Co-Designers

Elizabeth Koh, National Institute of Education, Singapore, elizabeth.koh@nie.edu.sg
Helen Hong, National Institute of Education, Singapore, helen.hong@nie.edu.sg

Abstract: Teachers play an important role as co-designers in the development of learning interventions in blended CSCL environments. However, when new pedagogy and technology are introduced, it may not be easy for teachers to thrive in such complex environments. It is therefore important to identify key knowledge bases required for teachers to teach effectively in new CSCL environments. Using the lens of Technological Pedagogical Content Knowledge (TPACK), the paper will examine two case studies of teachers who co-designed a CSCL tool for teamwork with a research team and implemented it in their classrooms. The paper reveals the interacting components of technology, pedagogy and content knowledge, and highlights strengths as well as growth areas for the teachers' further professional development. Through identifying and then building these knowledge layers, teachers will be able to harness tools and co-design proficiently and successfully in technological environments.

Introduction

Teachers play an important role as co-designers in the development of learning interventions in blended CSCL environments. Teachers not only provide the authentic realities of the classroom and the workable designs for the curriculum, they also implement the lessons and adapt the CSCL environments accordingly. Teachers have firsthand contextual understanding of student backgrounds, school curriculum requirements and even educational policies. However, in the process of making these pedagogical changes, teachers, as with all learners, have their own trajectory of growth and change. Teachers may feel challenged in different areas as they leverage affordances of the CSCL environments for teaching and learning, such as the use of the technological tool or in the teaching of content. Especially when new pedagogy and technology are introduced, it may not be easy for teachers to harness the affordances of new CSCL environments. It is therefore important to identify key knowledge bases required for teachers to teach effectively in these new environments. In technological environments, the Technological Pedagogical Content Knowledge (TPACK) framework is an established lens to illustrate the content, pedagogy, and technology knowledges as well as their interactions (Mishra & Koehler, 2006). It recognizes that teachers face complex issues in the blended learning classroom and seeks to make known the knowledges and skills that teachers should have in order to thrive in these environments. TPACK has been used in many ways such as for teaching teachers and developing courses (Tokmak et al., 2013), and in the analysis of teacher practices (Powell et al., 2015) in technology integration.

In a similar manner, this paper will utilize TPACK to draw out crucial knowledges and practices in one such CSCL environment. Besides connecting the CSCL tool with teaching practices, the TPACK lens also helps to identify needful areas for further professional development. In this paper, our research context involves a CSCL tool, My Groupwork Buddy (MGB), which was co-designed with a team of teachers, researchers, and web developers, in order to help students grow their teamwork competency and also to enable teachers to deepen their professional competency in teaching and facilitating teamwork competency in students. This paper reports on the first year of the project and focuses on the teacher enactments and adaptations of MGB in the classroom. Specifically, using the TPACK lens, we will examine the teacher practices of two cases of teachers from two different schools and classrooms. We ask, to what extent do teachers show professional competency (TPACK) in teaching and facilitating teamwork competency with MGB?

Technological Pedagogical Content Knowledge

TPACK arose from Shulman's (1986) research on pedagogical content knowledge (PCK) required for effective teaching. Shulman argued that successful teachers possessed PCK, which is a specialized form of knowledge that combined particular understandings and knowhow about teaching the content matter. Mishra and Koehler (2006) subsequently extended the work for technological contexts to include technological knowledge and how all these knowledges interact. In essence, TPACK has three foundational forms of knowledge: technological knowledge (TK), pedagogical knowledge (PK) and content knowledge (CK). Notwithstanding, intermediate forms of knowledge are also needed; these are the interacting knowledges: technological pedagogical knowledge (TPK), technological content knowledge (TCK) and pedagogical content knowledge (PCK), and technological pedagogical content knowledge (TPACK). Particularly, TPACK recognizes that a deep

understanding of all three types of knowledges is needed in order to integrate and teach effectively in technological environments.

The CSCL tool and environment: MGB

MGB is developed as part of a larger 2.5 year project using a design-based research approach to grow students' teamwork competency. Technically, it is a Single-Page Application with a student team chat, lesson pages, student rating and teacher monitoring features. Pedagogically, it is underpinned by the Team and Self Diagnostic Learning (TSDL) Pedagogical Framework which is grounded in key theories such as experiential learning and the learning analytics process model (Koh et al., 2016; Kolb, 1984; Verbert et al., 2013). The TSDL employs a four stage cycle: (1) immersing students' in concrete collaborative experiences, (2) building students' awareness of their teamwork competencies primarily through self and peer teamwork ratings, (3) engaging students in reflection and goal-setting, and, (4) monitoring students' teamwork competency changes. The project has also developed a measure for teamwork consisting four teamwork competency dimensions: coordination, mutual performance monitoring, constructive conflict, and team emotional support (Refer to Koh et al., 2016 for more details).

TPACK and MGB

Adopting the TPACK lens, we will analyze the teachers' knowledges and skills in the CSCL environment. Specifically, we will refer to teamwork as the content matter, MGB as the technological environment, and TSDL as the pedagogy. Each component of TPACK is elaborated below:

- CK: knowledge about teamwork concepts, i.e., teamwork dimensions.
- PK: knowledge and skills in applying teamwork strategies, facilitation strategies of group work, group discussion and reflections (both individually and team based), notably the TSDL framework.
- TK: knowledge and skills about the use of MGB, its affordances and constraints.
- PCK: knowledge and skills of how to apply TSDL to teach particular teamwork dimensions (content).
- TCK: knowledge and skills of representing teamwork concepts in MGB.
- TPK: knowledge and skills of how to use MGB with respect to the pedagogy of TSDL.
- TPACK: knowledge and skills of teaching and facilitating teamwork with MGB using TSDL.

Methodology

A case study approach is employed to address the research question. This provides a richer understanding of the use of the CSCL tool by the two teachers. Qualitative data pertaining to the teachers during the first year of co-designing and implementation was collected. The data sources are: lesson observations (including field notes of lessons and photographs and/or videos taken during lessons), teacher prepared slides (including modifications made by teachers from the researcher prepared slides), teacher email interviews, and meeting notes from face-to-face meetings between teachers and researchers. The data was thematically coded according to the TPACK lens for each case. This was followed by a cross-case analysis with iterative discussions by the authors to draw out the larger themes.

Study background: Case A and B

During this first year, two different teachers from two different co-ed Secondary schools were involved in implementing this project, teacher A and B. In both cases, the research team had several meetings with the teachers before the implementation to co-design the use of the CSCL tool in the curriculum specific to their schools. During the school term, the research team also touched base with each teacher at appropriate junctures to support the teacher's implementation.

Case A

Teacher A teaches the subject, Design and Technology, where student teams have to create a physical prototype of a useful device for a welfare organization. This project was 1 year long, and the teacher was observed for key lessons throughout the year, for the four terms. Two classes of 14 year old students were involved in the project. Teacher A is also the ICT subject head, and has been in this position for 4 years, having previously been a teacher for 6 years. He is a subject specialist, and not the students' form teacher.

Case B

Teacher B teaches the subject, Integrated Project Work, which is an inter-disciplinary subject combining Geography and English. This subject also emphasizes collaborative learning. Student teams have to complete a series of investigations related to water and one of the final outputs was the creation of a product or activity to highlight the issues of water shortage and water conservation. This project was 6 months long (Term 3 and 4), and the teacher was observed for 6 lessons. One class of 13 year old students was involved in the project. Teacher B was a relatively new teacher with 3 years of experience. This was the first time she was teaching this subject at Secondary 1. She is also the students' form teacher.

Analysis

Table 1 provides the individual and cross-case comparison.

Table 1: TPACK of the two cases.

	Teacher A	Teacher B
CK	Took some time to learn what the 4 teamwork dimensions are. But could explain them well at Term 4 with examples.	Took some time to learn the 4 teamwork dimensions. By the end of the 6 months, could explain the dimensions briefly but got mixed up at times, and the dimensions were not understood at a very deep level.
PK	Is familiar with teamwork awareness but not the reflection aspect. Utilizes the design thinking approach in his pedagogy.	More comfortable with facilitation of group work in the classroom as compared to the computer lab (the latter point will be addressed in TPK). Taught in a structured way to scaffold and guide students to produce "good reflections"
TK	Very knowledgeable. Uses technology pervasively in classes. Very comfortable using ICT to teach.	Keen to use and explore the affordances of MGB.
PCK	Thought about the delivery of the lesson, created and modified slides to suit the implementation. However, did not hold tight to the "product" aspect of the reflection, but approached it more as a process. Warned students that they might have to stay back if they did not do the activity properly, although this was just once.	Reflection is treated as one of the "products" of learning, used for summative assessment. Therefore, the teacher scaffolded and explicitly taught students how to reflect and write reflections.
TCK	Understood teamwork concepts in MGB and proactively instructed students to write specific and timely targets for their teamwork goal-setting (personal and team).	Used MGB to monitor students' individual and team progress.
TPK	Some aspect was developed such as knowing how to get students to rate self and peers. During the teamwork reflections, the teacher emphasized the process, informing students to "refine" reflections where necessary. A similar approach was adopted for the goal-setting. However, this teacher did not use MGB to help monitor students' teamwork. He was not sure how serious students would be toward responding to the activity.	Faced difficulty in classroom management at the computer lab, compared to the classroom. Was not able to use the curriculum time efficiently, resulting in students having to wait and not being engaged when instructions were given. When facilitating the reflection on the system, emphasized that students can "re-do" their reflections if they did not do it well the first time.
TP-ACK	As a whole, generally competent by Term 4. Also, from the start of the implementation emphasized the total integration of MGB in the curriculum. "When students think of the subject, they should think of MGB".	Competent but viewed MGB from summative assessment lens and an add-on to the curriculum instead of integration.

Discussion and conclusion

Bearing in mind the contextual differences of the two cases, our cross-case analysis illustrates learning challenges and differing trajectories for both teachers as they embark on the process of co-designing and implementation. Both teachers had gap areas of knowledges which were subsequently shown to be picked up as the project went on. Though it took them a while to learn the four teamwork dimensions and use the right terminology in their lessons, both teachers were able to explain the dimensions to their students by the end of the project. However, this was weaker in Teacher B; her understanding of teamwork could be deepened.

When there is wider misalignment of TPACK understanding, we found the teacher experiencing a steeper learning curve. For example, though both teachers were familiar with the use of technology for teaching (TPK), Teacher B was less adept at orchestrating a class of 40 students to use the system in the computer lab,

resulting in some time loss due to classroom management issues. This can be attributed to her lack of knowledge and experience and highlights an area for further professional development.

Interestingly, in the same CSCL environment, different practices were exhibited by teachers in the co-designing process. Teacher A was proactive in giving suggestions to improve MGB while Teacher B focused on harnessing the current affordances of the existing tool e.g., tracking and monitoring students' progress and working as a team.

Although both teachers followed the TSDL framework, their PCK and TPK showed different teaching emphasis, which also reveals their teaching beliefs. Teacher A is more focused on the process of the activity, while Teacher B emphasized the product of the artefacts created by students during the activity. These two emphases have their own strengths and weaknesses. More importantly, both approaches meet the needs of the teachers employing them, as teachers have first-hand and crucial contextual understanding of their classroom and the curriculum outcomes of the school. On the same note, teachers' interpretations of their own accountability and their students' autonomy, likewise influences their emphasis in co-designing and lesson implementation. In Case B, it was a focus on summative instead of formative assessment, holding students accountable for their reflections and scaffolding their learning to write reflections while in Case A it was to give students room to make changes along the way.

As a whole, Case A demonstrated greater TPACK, with the emphasis of total integration rather than separating the tool and activity from the rest of the curriculum. Nevertheless, different aspects of TPK could be strengthened such as harnessing the monitoring features of MGB. For Case B, while there are several gap knowledge areas, we acknowledge that this teacher had less time to develop her professional competency. Giving the teacher time and support with relevant TPACK training would help her trajectory of growth.

The TPACK lens has been useful for identifying the areas of challenges and growth in the two cases. This systematic approach helps to highlight areas in which the research team can provide greater professional development support and enhance the design of the CSCL tool. This recognition of the interacting components of technology, pedagogy and content knowledge testaments to the complexities that teachers face in effective technology implementation. Yet, through building these knowledge layers, teachers will be able to harness tools and co-design proficiently and successfully in technological environments.

References

Koh, E., Shibani, A., Tan, J. P.-L., & Hong, H. (2016). A pedagogical framework for learning analytics in collaborative inquiry tasks: An example from a teamwork competency awareness program. In *Proceedings of the Sixth International Conference on Learning Analytics & Knowledge* (pp. 74-83). Edinburgh, United Kingdom: ACM.

Kolb, D.A. (1984). *Experiential learning: Experience as the source of learning and development*. Englewood Cliffs, NJ: Prentice-Hall.

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, *108*(6), 1017-1054.

Powell, A. B., Alqahtani, M. M., & Weimar, S. (2015). Examining teachers' support of students' learning of dynamic geometry in a CSCL environment. In *Proceedings of the 11th International Conference on Computer Supported Collaborative Learning* (pp. 671-672). Sweden: The International Society of the Learning Sciences.

Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, *15*(2), 4–14. doi:10.3102/0013189x015002004

Tokmak, H.S., Yelken, T.Y., & Konokman, G. Y. (2013). Pre-service teachers' perceptions on development of their IMD competencies through TPACK-based activities. *Educational Technology & Society*, *16*(2), 243–256.

Verbert, K., Duval, E., Klerkx, J., Govaerts, S., & Santos, J. L. (2013). Learning analytics dashboard applications. *American Behavioral Scientist*, *57*(10), 1500-1509.

Acknowledgements

This paper refers to data and analysis from the research projects NRF2015-EDU001-IHL08, funded by the eduLab Funding Programme, MOE-NIE initiative, and OER 09/15 EK, funded by the Education Research Funding Programme, NIE, Nanyang Technological University, Singapore. The views expressed in this paper are the authors' and do not necessarily represent the views of NIE.