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Investigation on the shared mental model and team performance of teacher design team for technology integration in education

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1. Introduction

There is an increasing demand for teacher to design technology integration courses since the more and more digitized society and education. However, many challenges and issues have emerged such as considerable time might be spent on course design and development, adapting to new online forms of learning activities. In the professional development field, the collaboration between teachers have been as a main method for teacher learning.

Although the value of teacher collaboration for professional development has been recognized in many western nations, it has not been systematically investigated, particularly in Asian contexts (Yeh, 2007). Therefore, the need arises to generate insights into aspects of teacher collaboration for technology integration.

2. Research Background

In China, even though there are many teachers' trainings about basic technology skills, continuous education that focuses on the pedagogical use of technology in instruction missing. Therefore the potential of technology in the classroom is hardly realized. Voogt et al. (2011) indicated that teacher education needs to be situated in authentic contexts such as the community of teacher and the school environment. One way to comply with these features of effective teacher professional development is to engage teachers in collaborative design team for technology-enhanced instruction (Handelzalts, 2009; Simmie, 2007; Voogt, 2010). Developments in the learning sciences (Bransford, Brown, & Cocking, 2000) have shown that people could benefit from situated contexts, when they are actively involved in the learning process and collaboration with others (Cobb, 1994; Greeno, 1998). This review of the literature emphasizes that teams operate complex tasks that are too complex to be done by individuals. It is clear that people who work in teams and share the same goals perform better than people working by themselves. Researchers in the teacher professional development field (Borko, 2004) have initiated these findings for teacher professional development by organizing teacher design team.

Although teacher design team has been seen as a promising method for teacher education, Bell et al. (2005) indicated that the collaborative inquiry was also a demanding way for performance improvement. Teacher design teams (TDTs) are defined as teams of more than two teachers who collaboratively design instruction process and materials, with the aim of improving their own instructional practice (Handelzalts, 2009). It is necessary to examine the collaborative processes in teacher design teams that promote teacher learning: the interaction with peers, facilitators and external stimuli, the experimentation in classroom practice, and the factors in the environment that hinder or facilitate teachers' collaborative design. Therefore, we focus on the processes of collaborative design in teacher designs teams that foster teacher learning and development.

3. Methodology

3.1 Research Objectives

The conceptual framework is illustrated in Figure 1. Team process includes the shared mental model and team interaction. Shared mental model (SMM) are organized mental representations of knowledge about team's environment that are shared by team members (Johnson et al., 2007). It has been used interchangeably with team mental model and shared cognition to explain team functioning. As team members work with each other, they start to develop shared mental models about the team and the task. Team interaction, which mean the communication and coordination between teammates, have a critical influence on the development of team shared mental model as well as team performance. Understanding the team process advances our understanding of teamwork and team decision-making that correlates with the team performance. This framework also focuses on the transformation of team performance to individual technology-integration teaching behavior.

The following research questions guide our study:

1) What has teacher team actually done for design technology-enhanced learning for students learning?
2) How is the team process related with the team performance?
3) How does the outcome of teacher design team benefit teachers' following technology integration teaching behavior?

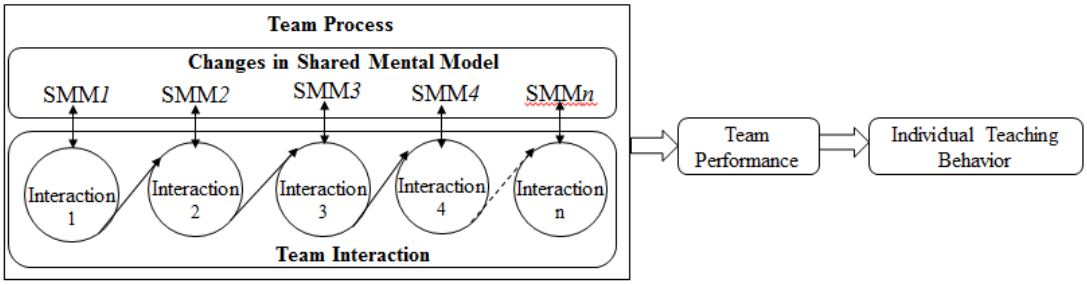

Fig. 1 Conceptual Framework

3.2 Participants

We conducted this study in an educational master's class. 46 student teacher (21 males and 25 females) formed this class and all of the them had less than 5 years teaching experiences in Chinese K-12 schools. During this class, they would design online inquiry course on WISE (Web-based Inquiry Science Environment) platform in groups. Each group had a detailed schedule for discussing how to design the course, for example, they will have a meeting every one or two weeks.

3.3 Instrument

After every two-week period, participants were asked to complete a team assessment diagnostic instrument (TADI) and a team communication tracking instrument (TCTI) (Padmo, 2013). The goal of the TADI is to measure each team member's shared mental models (SMM). Johnson et al. (2007) identified five team and general task SMM factors in the TADI: (1) task and team knowledge, (2) communication skills, (3) attitude toward teammates and task, (4) team dynamics and interactions, (5) team resources and working environment. The SMM factors were measured using a 5-point Likert-type scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The TCTI records the types and frequency of communication used by team members as they design instruction that integrates technology. Teams could use a variety of communication channels such as face-to-face, telephone, email, audio computer conference, letters, or other means of communication. The TCTI questionnaire records type of communication channels that were used and how frequently team members communicate with each other over a two-week period.

As for the team performance, our research will use the task completion instrument and team performance product quality instrument (TP-TCI/PQI) to measure task completion and design quality (Padmo, 2013). Task completion was measured by comparing the number of tasks that were actually completed to the number of tasks that should have been completed. The TP-TCI contained a checklist of "yes" and "no" responses for product completion overall, as well as by sections (i.e., the introduction section, content section, and closing section). The product quality instrument (TP-PQI) used a Likert-type scale ranging from 1 (poor) to 5 (very good) for each criterion. The internal consistency of the instrument produced a Cronbach alpha coefficient of .69 for the introduction section, Cronbach alpha coefficient of .73 for the content presentation section, and a Cronbach alpha coefficient of .59 for the closing section.

In addition, we also recorded the talk of teacher group. The design task would be separated into several sub-tasks such as analyzing, planning, constructing and reflecting.

3.4 Data analysis

The data analysis will involve assessing the differences interaction and SMM in among different stages. The data will be analyzed using SPSS 22.0. Paired t-test is used to compare the changes in shared mental model and team interaction. Mediation multiple regression is used to test whether the team interaction mediates the relationship between SMM and team performance. The correlation analysis will be used to test the relationship between team performance and individual teaching behavior.

4. Contribution of the work

The main contribution of this study is the synthesis of the coding scheme from different perspectives, which will allow the possibilities for gaining deep investigation for the teacher collaborative design for ICT integrations.

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