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EXAMINATION OF PRE-SERVICE TEACHERS' TECHNOLOGY INTEGRATION AND THEIR TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE

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Abstract: How technology is integrated to the lessons is important because what is meant by teachers' use of technology varies widely. Therefore, the purposes of this study were to determine pre-service physics teachers' TPCK and to examine their technology integration skills during their practices. Technological pedagogical content knowledge frames this research. The participants of the study were senior pre-service physics. In order to measure the participants' true knowledge, ability, and practice about TPCK, data were collected by using mixed-methods including observations, lesson plans, and interviews. Results of this study conclude that pre-service physics teachers can reflect technology integration to their practices more successfully than to their lesson plans. They can behave like an expert while using CBL technology in their teaching. Although they know how to use technology effectively, some of them need to improve their knowledge and realize that technology is not a vitamin whose mere presence catalyzes better educational outcomes. In addition, pre-service physics teachers have high level TPCK; hence, they have tendency to use technology and have a coherent knowledge about technology, pedagogy and content. This study suggests that various technologies should be introduced in teacher education programs and teacher candidates should use these technologies as tools to gain progress in advancing their TPCK.

***Keywords*:** Pre-service teachers, TPCK, technology integration.

Introduction

Technology has begun to take a crucial role in education; therefore, there has been substantial investment on technological tools in order to integrate technology to the science teaching. However, how technology is integrated to the lessons is important because what is meant by teachers' use of technology varies widely (Bebell, Russell & O'Dwyer, 2004). Therefore, the purposes of this study were to determine pre-service physics teachers' TPCK and to examine their technology integration skills during their practices.

Theoretical Framework

Technological pedagogical content knowledge frames this research. Teachers should need to have a coherent knowledge about technology, pedagogy and content. Technological Pedagogical Content Knowledge, known as TPCK or TPACK, has become theoretical framework of teacher knowledge for technology integration. TPCK framework allows us to make sense of the complex web of relationships that exist when teachers attempt to apply technology to the teaching of subject matter (Mishra & Koehler, 2006). In recent years, researchers described TPCK within Schulman's (1987, 1986) framework description of Pedagogical Content Knowledge (PCK). TPCK is an extension of PCK and is achieved when a teacher knows (Graham and others, 2004);

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1) How technological tools transform pedagogical strategies and content representations for teaching particular topics,
2) How technology tools and representations impact a student's understanding of these topics.

According to Koehler and Mishra (2008), TPCK has three components: PCK, TPK (Technological Pedagogical Knowledge) and TCK (Technological Content Knowledge). PCK is the connection and relation of pedagogy and content knowledge. TPK represents the integration of technology with general pedagogical strategies. It is related to engage students with technology effectively in the learning process. TCK represents knowledge of technological tools that are used by teachers within content. Consequently, TPCK, that is center of the model, represents the usage of technology to provide content and pedagogical strategies.

Literature Review On Tpck And Technology Integration

Teachers must not focus on the technology itself, but rather on the learning outcome that is supported by technology (Millen, 2015). Teachers' knowledge to integrate content, pedagogy and technology has become important. As a result, a quite number of studies have been focused on to examine how teachers and teacher candidates integrate technology into their teaching and to determine their TPCK. Due to the fact that self-report instruments were generally used to discover teachers' TPCK in the studies (Archambault & Crippen, 2009; Forssell, 2011; Liang, Chai, Koh, Yang, & Tsai, 2013; Jang & Tsai, 2013), the results might not reflect what TPCK these teachers actually would perform during their practices.

Because confidence in TPCK is different from confidence in using technology more generally, it is important to create opportunities for teachers to learn how new technologies support their specific goals in the grade, subject area, and school context in which they teach (Forssell, 2011). Therefore, Koh and Divaharan (2013); Lowder (2013); Mudzimiri (2012) and Sabo (2013) developed teacher education courses and studied the participants' TPCK. Some research investigated teachers' technology integration (Inan & Lowther, 2010; Stoilescu, 2011). The review of research on TPCK suggests that more research is needed to explore how science teachers integrate specific technology in their teaching practices by collecting data from various methods including observing and interviewing.

Purposes of the Study

Assessing TPCK requires focus on a specific technology using in a particular context and in support of a clear set of curricular objectives, and it will require some measure of teachers' PCK as well (Forssell, 2011). Thus, the research questions put a light on this study are as follows:

1. What is pre-service physics teachers' technological pedagogical content knowledge?
2. How do pre-service physics teachers integrate calculator based laboratory (CBL) technology into their practices?

Methodology

Case study design (Stake, 1995) was guided to the research. The participants of the study were 10 senior pre-service physics teachers, three of whom were male. Science teachers could develop their TPCK through using technological tools in science teaching (Jang & Tsai, 2013). Therefore, the participants enrolled in a course titled as "Technology Integration in Physics Teaching". One of the researchers was the instructor of the course. Since teaching with technology requires complex skills and understandings, the participants had opportunity to learn and integrate Calculator-Based Laboratory (CBL) technology into teaching of various physics subjects in this course. Then, they designed and implemented a lesson plan about the physics concepts. Before starting to implementation, the participants' CBL knowledge and skills were measured to make sure that all the participants learned this technology. In order to measure the participants' true knowledge, ability, and practice about TPCK, data were collected by using mixed-methods including observations, lesson plans, and interviews.

The pre-service physics teachers' skills while they were integrating the CBL technology into their teaching were observed by two researchers. Science Classroom Observation Rubric (SCOR) developed by Burry-Stock and Oxford (1994) was filled out by the researchers separately for each participant. Another data source was the pre-service physics teachers' lesson plans they prepared in detail. Moreover, interviews were conducted with the

participants just after their practices to understand their thoughts about technology integration and to evaluate their practices. Five point scoring rubrics were created by the researchers to analyze the participants' lesson plans transcripts gathered from the interviews.

Conclusions and Suggestions

Results of this study conclude that pre-service physics teachers can reflect technology integration to their practices more successfully than to their lesson plans. They can behave like an expert while using CBL technology in their teaching. Although they know how to use technology effectively, some of them need to improve their knowledge and realize that technology is not a 'vitamin' whose mere presence catalyzes better educational outcomes (Dede, 2001). In addition, pre-service physics teachers have high level TPCK; hence, they have tendency to use technology and have a coherent knowledge about technology, pedagogy and content.

Using technology might stimulate teachers' confidence and self-efficacy, so that they become more successful in their teaching. Future research must expand on this possibility. This study suggests that various technologies should be introduced in teacher education programs and teacher candidates should use these technologies as tools to gain progress in advancing their TPCK.

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