Technological Pedagogical Content Knowledge Development of Turkish Pre-service Teachers of English

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Abstract: Changes having occurred in the field of education have affected the body of knowledge that teachers need to promote successful language learning of their students (van Olphen, 2008). The present study aims to examine the TPACK development of Turkish PTs of English as they participated into a study explicitly focusing on the framework of TPACK and designed following Learning Technology by Design approach. Participants were 22 PTs enrolled in the ELT program of a state university in Istanbul, Turkey. During the 12-week study, PTs were informed about the TPACK framework, explored various technologies collaboratively, developed technological materials, designed technology-integrated lessons and taught in a real classroom setting. Data came from the adapted version of the Survey of Pre-service Teachers' Knowledge of Teaching and Technology (Schmidt, et al., 2009). Results showed that there was a statistically significant increase in TK, TCK, TPK and TPACK scores of PTs of English from the beginning to the end of the study.

Theoretical Framework

Technology has become a significant aspect of life in the 21st century. All spheres of education have been influenced by this phenomenon and there has been an increasing interest in the application of computers and computer-related technology in the classroom. As new advanced technologies have come to the classrooms, traditional conceptions of what constitutes a classroom, how learning occurs and the role of the teacher and qualities of teacher knowledge bases are all challenged by the capabilities of new technology.

Teacher knowledge has been reported as one of the key barriers for effective technology integration (Hew & Brush, 2007; Mishra & Koehler, 2006). The issue of what teachers need to know about technology for effective teaching has been the centre of intense debate in the recent past (ISTE, 2002; Zhao, 2003). It is clearly stated that the mere introduction of technology to the classrooms will not have the desirable outcomes as "it is what people do with the machine, not the machine itself that makes a difference" (Mehan, 1989, p. 19). Similarly, Koehler and Mishra (2005) stated that the adoption of new technologies does not guarantee successful teaching and learning experiences. They emphasize the importance of focusing on identifying what teachers need to know about the role of technology to be effective in the classroom (Mishra & Koehler, 2006). In other words, the construction of a knowledge base for teachers is crucial for effective integration of technology into their teaching and for expecting teachers to add technology education to the learning areas that they are required to teach.

Technological Pedagogical Content Knowledge (TPACK) has been introduced as conceptual framework for teacher knowledge needed for effective technology integration (American Association of Colleges of Teacher Education, 2008; Koehler & Mishra, 2008; Mishra & Koehler, 2006, 2008). The TPACK framework builds on Shulman's construct of pedagogical content knowledge (PCK) which refers to "the most powerful analogies, illustrations, examples, and demonstrations – in a word, the ways of representing and

formulating the subject that makes it comprehensible to others" (1996, p.9) to include technology knowledge. The framework consists of three main components of knowledge, i.e., content (CK), pedagogy (PK) and technology (TK) and their intersections represented as pedagogical content knowledge (PCK), technological content knowledge (TCK), technological pedagogical knowledge (TPK) and technological pedagogical content knowledge (TPACK). Mishra and Koehler describe TPACK as follows:

> TPACK is the basis of good teaching with technology and requires an understanding of the representation of concepts using technologies; pedagogical techniques that use technologies in constructive ways to teach content; knowledge of what makes concepts difficult or easy to learn and how technology can help redress some of the problems that students face; knowledge of students' prior knowledge and theories of epistemology; and knowledge of how technologies can be used to build on existing knowledge and to develop new epistemologies or strengthen old ones (2006, p. 1029).

Teacher education has become a key area for the implementation of the TPACK framework (Maor & Roberts, 2011). Hofer and Grandgenett (2012) mentioned that in teacher education programs, various courses and field experiences help pre-service teachers (PTs) develop their TPACK. A number of research studies have been carried out among the PTs of different subject matters such as science, mathematics or social studies to investigate the effects of these courses on their TPACK development.

Cavirn (2007) investigated the development of TPACK in six PTs from mathematics and science education majors as they participated into a micro teaching lesson study (MLS) process. During the MLS, the instructor modelled technology-enhanced instruction with PTs as students; PTs kept written reflections on each modelled instruction; and PTs developed and micro taught a content area lesson plan integrating technology. The findings of the data coming from audio recordings of group meetings, video recordings of micro teaching, interviews and PTs' written reflections revealed that they began to consider the relationship among content, pedagogy and technology, indicating a progress in their TPACK and did modifications in their plans and teaching to enhance the effectiveness of the lesson.

In a more recent study, Koh and Divaharan (2011) worked with PTs to help them develop their TPACK through a design project which involved using interactive whiteboards (IWBs). The participants were 74 PTs enrolled in an educational technology course. The researchers developed TPACK-Developing Instructional Model which was based on the following three phases: (1) faculty modelling of a new ICT tool; (2) building technical proficiency and pedagogical modelling; (3) and pedagogical application. Data came from pre- and post-surveys to examine PTs' level of confidence and attitudes towards the use of IWB and PTs' end-of-class reflections. Data analysis showed that PTs built their confidence in integrating IWBs into their teaching and their high level of positive attitude toward IWBs stayed high throughout the study. The reflections of PTs revealed no significant focus on TPACK throughout the study but while PTs emphasized TK at the beginning of the study, TPK became their focus when the study ended.

In their study with PTs of various subjects such as mathematics, biology and social sciences, Hofer and Grandgenett (2012) focused on the development of TPACK through a three-semester teacher preparation program. During the program, PTs received general coursework on education in the first semester, content-specific teaching methods course with practicum experience, content reading and writing, an educational technology course and a course on classroom management issues in the second semester and courses on classroom-based assessment, collaboration with families and school personnel, and a content based instructional planning course with practicum experience in the final semester. PTs completed the semester with a student teaching experience at their practicum sites. Data were collected at the beginning of the first semester, at the beginning and end of the fall semester, and at the end of the spring semester through the TPACK survey (Schmidt et. al., 2009), structured reflections, and lesson plans. Findings of the survey showed significant growth in PTs' TPACK throughout the study. PTs' lesson plans demonstrated adequate TPACK though the scores on the plans revealed a slight decrease during the student teaching semester from the fall semester. Finally, PTs' reflections demonstrated that PTs mostly focused on their TPK for technology integration.

The present study seeks to contribute to the literature on how TPACK framework can guide the development of PTs' effective technology integration skills. Specifically, the aim of the present mixed methods study was twofold: (1) to examine the TPACK development of Turkish PTs of English as they participated into a study explicitly focusing on the framework of TPACK and designed following Learning Technology by Design approach; and (2) to investigate how this knowledge was reflected in PTs' lesson plans and presentations. Due to the limited space, only the first research question based on the quantitative data will be discussed below.

Methodology

Participants

Participants of the present study were 22 Turkish PTs, all volunteers, enrolled in the final year of a four-year English Language Teaching program of a state university in Istanbul, Turkey. PTs received two courses in their freshman year focusing on the development of basic computer skills, such as word processors, email, spreadsheets and Internet searches. Due to the lack of technology-trained faculty, the participating PTs had not received any training on technology integration in language teaching although such a content-specific educational technology course is offered in the sophomore year of teacher education programs in Turkey.

Procedure

For the purposes of the study, a 12-week course was designed to help PTs develop their TPACK. The participating PTs met with the instructor, one of the researchers, in a computer lab for three hours weekly. The course design attempted to adhere to the following four principles: (1) skills were developed via Learning Technology by Design approach (Mishra & Koehler, 2006) (2) design tasks were problem-centred (Merrill, 2002); (3) PTs worked collaboratively (socio-cultural theory); and (4) PTs engaged in reflective practice (Schon, 1983).

The course was conducted as follows: In the first week, pre-data were collected and PTs were informed about the study in detail. There was also a class discussion on the importance of technology integration in the 21st century. During the weeks two, three and four, class discussions focused on the importance of technology integration in English Language Teaching (ELT), on the meaning and different uses of technology and on the concept of TPACK. PTs read some articles assigned by the instructor so that they could contribute to the discussions. Weeks five and six were based on the collaborative presentations of PTs on the technological tools they have chosen. For these presentations, PTs were supposed to work in groups, choose a technology to explore, teach their classmates how to use it, and then focus on its use for language teaching purposes. At the end of week six, PTs were informed about the tasks for the remaining weeks of the study, when the coursework would be combined with the practicum. PTs were supposed to prepare a lesson plan, peer teach it, receive feedback from their peers and the instructor, modify it, and follow the final version of the plan for macro teaching at their practicum schools. While doing so, PTs were to consider the learners that they would be teaching at the school site in terms of their age, proficiency level, technology available and students' familiarity with technological tools. In their planning, PTs were also expected to anticipate potential problems and think of solutions for each. In weeks seven and eight, PTs did peer-teaching of their technology integrated lesson plans. Based on the feedback they received, PTs modified their plans and implemented them in their practicum schools (macro teaching) (Weeks 9 and 10). In Week 11, PTs shared their experiences of macro teaching with each other and with the instructor. They reflected on their experiences in their practicum schools and commented on each other's stories. In the final week (Week 12), post-data were collected and the study ended.

Data Collection and Analysis

In order to explore the development of TPACK and its technology related components (TK, TCK, TPK), quantitative data were collected using the Survey of Pre-service Teachers' Knowledge of Teaching and Technology (Schmidt, et al., 2009). The survey with 47 questions referred to the seven categories of the TPACK framework and were answered on a 5-point Likert scale ranging from 5 (strongly agree) to 1 (strongly disagree). As the scale originally covered the content areas of social studies, mathematics, science and literacy, it was adapted to the content area of English language teaching. The adapted version included 29 items and it was piloted with 50 PTs in the same institution for reliability purposes.

The collected data were analyzed via SPSS 13 statistical package. Dependent means t-test was applied to the data coming from the technology related knowledge domains of the TPACK survey. For the pre- and post-test differences in each sub-scale, *t*-statistics, *p*-values and eta squared measures were calculated.

Results

The findings of the t-test revealed that there was a statistically significant increase in TK, TCK, TPK and TPACK scores of PTs of English from the beginning to the end of the study. The eta squared values found for each subscale was .62 for TK; .74 for TCK; .75 for TPK and .81 for TPACK, all implying a large effect, with a substantial difference in the technology related subscale scores before and after the study. Table 1 presents the t-test findings for the four subscales.

Table 1: The results of the Dependent t-test

Scale		M	SD	SE	T	df	p*
TK (n= 22)	Pre	3.47	.69	.15	-5.87	21	.000
	Post	4.29	.44	.09			
TCK (n= 22)	Pre	3.41	.91	.19	-7.09	21	.000
	Post	4.64	.49	.10			
TPK (n= 22)	Pre	3.39	.66	.14	-7.66	21	.000
	Post	4.67	.40	.08			
TPACK (n= 22)	Pre	2.82	.65	.14	-9.41	21	.000
	Post	3.76	.37	.08			

***** *p<.001*

Discussion and Conclusion

The present study showed that the coursework explicitly focusing on the TPACK framework, designed following the Learning Technology by Design approach and combined with fieldwork developed PTs' TPACK and technology related knowledge domains, i.e., TK, TCK and TPK significantly. The eta squared values indicated the largest effect for the TPACK component. While PTs had a very low self-reported level of TPACK at the beginning of the study, a significant increase could be observed in their expressed level of TPACK when the study ended. This finding demonstrated that PTs began to consider the relationship among content, pedagogy and technology for effective language teaching.

When the mean scores were analyzed in detail, it could be seen that the highest mean score (4.67) belonged to the TPK domain at the end of the study reflecting PTs' high confidence in choosing technologies that enhance the teaching approaches and students' learning in a lesson.

Although not included in the present paper, the qualitative data, i.e., written reflections, interviews, lesson plans, classroom observations and field notes, collected from purposefully selected 6 cases supported the findings of the TPACK survey. At the beginning of the study, before the treatment, most of the cases treated technology in isolation. However, as the study progressed, they began to consider technology in relation to content and pedagogy, which was evident in their comments. Their developed understanding of the relationship among content, pedagogy and technology was also reflected in the lesson planning and implementation processes of the PTs who worked hard to improve the quality of their lessons by integrating technology effectively.

The findings of the present study were in parallel to the findings of similar studies conducted by Cavirn (2007), Koh and Divaharan (2011) and Hofer and Grandgenett (2012). In their studies, PTs were provided with some coursework and the opportunity of designing their own lessons, which caused increase in their TPACK. In the present study, learning about the TPACK framework explicitly, developing technological materials, designing technology-integrated lessons and teaching them in a real classroom setting might also have helped PTs of English develop their TPACK in relation to EFL teaching.

The present study has got a number of implications for teacher education programs. First, technology related courses offered to PTs should go beyond the isolated skills instruction and teach PTs explicitly how to consider technology, content and pedagogy together for effective instruction in a particular subject area. Second, throughout the present study, PTs of English worked as "designers." They created technology integrated lesson plans in their subject area for a particular group of students. They, then, implemented their plans in a real classroom setting. Such an experience helped PTs to understand the importance of TPACK, in practice, and discover their creativity for an effective integration of technology. Thus, teacher education programs should give PTs the opportunity of becoming the designers of their own lessons rather them dictating to them certain ways of integrating technology as there is not one solution to the problem of technology integration. Finally, the courses offered to PTs for technology integration should combine coursework with fieldwork. In other words, theory and practice should be combined to equip PTs with the necessary skills of technology integration. Without the experience and expertise needed to effectively engage with technology, pre-service teachers, if they use technology at all, tend to use it in superficial, low-level ways (Doering & Veletsianos, 2008).

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