Developing Technological Pedagogical Content Knowledge of Turkish pre-service teachers of English through a design study

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ABSTRACT

Developing Technological Pedagogical Content Knowledge of Turkish pre-service teachers of English through a design study

By

Gökçe Kurt

The present study investigates the development of Technological Pedagogical Content Knowledge (TPACK) of Turkish pre-service teachers of English through a design study. More specifically, the study aims to examine how a coursework explicitly focusing on the framework of TPACK and designed following the Learning Technology by Design approach helps develop the TPACK of Turkish pre-service teachers of English who were given the opportunity to apply what they learned in their coursework to their field-experience.

The following research questions guided this study.

1. Will there be a significant change in the TPACK (TK, TCK, TPK and TPACK) of pre-service teachers of English as they participate in a design study?
2. Will pre-service teachers' TPACK be reflected in their instructional practices?

Twenty-two pre-service teachers of English enrolled at the English Language Teaching Department of Marmara University, Turkey, participated in this study. For the purposes of the present study, PTs received the specifically designed coursework as a treatment for 12 weeks.

For the treatment, the TPACK framework was applied and the Learning Technology by Design theory was adapted to the context. Coursework and fieldwork were combined and certain types of experiences and learnings were planned to bring the TPACK. The course design attempted to adhere to the following four principles: (1) design tasks were problem-centred (Merrill, 2002); (2) skills were developed via Learning Technology by Design

Approach (Mishra & Koehler, 2006); (3) PTs worked collaboratively (socio-cultural theory); and (4) PTs engaged in reflective practice (Schon, 1983).

Quantitative data coming from the pre- and post-test scores of 22 PTs collected by the Survey of Pre-service Teachers' Knowledge of Teaching and Technology (Schmidt, et al., 2009) revealed statistically significant development in the TPACK and its technology related components for all participating PTs.

Qualitative data obtained from the written reflections and interviews of the six cases purposefully chosen among the 22 PTs also supported this finding and showed that, as the study progressed, PTs began to consider the relationship among content, pedagogy and technology. Further analysis of the cases' lesson plans and macro teaching observations also proved that PTs' developed TPACK was reflected in their lesson plans and practice teaching during the practicum.

Hence, the results of the study indicated that a coursework combined with fieldwork, following the TPACK framework and based on Learning Technology by Design Approach can be utilized as an effective program in universities to develop PTs' subject-specific technology integration skills.

KISA ÖZET

Türk İngilizce öğretmen adaylarının Teknolojik Pedagojik Alan Bilgisi gelişimi

Gökçe Kurt

Bu çalışmanın amacı, İngilizce öğretmen adaylarının özel bir çalışma yoluyla Teknolojik Pedagojik Alan Bilgilerinin gelişimini araştırmaktır. Başka bir deyişle, bu çalışma teori ile pratiği birleştiren, Teknolojik Pedagojik Alan Bilgisi Modeli üzerine kurulu ve Teknolojiyi Tasarım Yolu ile Öğrenme yaklaşımına dayalı bir çalışmaya katılan Türk İngilizce öğretmen adaylarının Teknolojik Pedagojik Alan Bilgilerinin nasıl geliştiğini araştırmayı hedeflemektedir.

Çalışmada aşağıdaki araştırma soruları cevaplanmıştır:

1. Tasarım çalışmasına katılan İngilizce öğretmen adaylarının Teknolojik Pedagojik Alan Bilgisi ve onun teknolojik bileşenlerinde (Teknolojik Bilgi, Teknolojik Alan Bilgisi, Teknolojik Pedagojik Bilgi ve Teknolojik Pedagojik Alan Bilgisi) anlamlı bir gelişme olacak mıdır?
2. İngilizce öğretmen adaylarının Teknolojik Pedagojik Alan Bilgileri öğretim süreçlerine yansıyacak mıdır?

Türkiye'de Marmara Üniversitesi İngilizce Öğretmenliği bölümünde öğrenim gören 22 öğretmen adayı çalışmaya katılmıştır. Araştırmanın amacı gereği, öğretmen adayları 12 hafta süren tasarım çalışmasına katılmışlardır.

Tasarım çalışması Teknolojik Pedagojik Alan Bilgisi Modeli izlenerek ve Teknolojiyi Tasarım Yolu ile Öğrenme yaklaşımına dayalı olarak hazırlanmıştır. Ayrıca, teori ve pratik birleştirilerek, öğretmen adaylarının Teknolojik Pedagojik Alan Bilgilerinin geliştirilmesi hedeflenmiştir. Tasarım çalışması 4 prensibe dayalı olarak hazırlanmıştır: (1) tasarım görevleri problem odaklıdır (Merrill, 2002); (2) gerekli beceriler Teknolojiyi Tasarım Yolu ile

Öğrenme yaklaşımı ile geliştirilmiştir (Mishra & Koehler, 2006); (3) öğretmen adayları beraber çalışmışlardır (sosyo-kültürel teori); (4) öğretmen adayları düzenli olarak düşüncelerini yansıtmışlardır (Schon, 1983).

Nicel veri, öğretmen adaylarına çalışmanın başında ve sonunda uygulanan Öğretmen Adaylarının Öğretme ve Teknoloji Bilgisi Anketi (Schmidt, et al., 2009) yoluyla toplanmış ve elde edilen veriler öğretmen adaylarının Teknolojik Pedagojik Alan Bilgilerinin çalışmanın sonunda anlamlı şekilde geliştiğini göstermiştir.

Nitel veri, 22 öğretmen adayı arasından amaçlı örneklem yöntemi ile seçilmiş 6 öğretmen adayının yazılı düşüncelerinden ve onlarla yapılan yüz yüze görüşmelerden elde edilmiştir ve nitel veri analizi göstermiştir ki, çalışma ilerledikçe, öğretmen adayları Alan Bilgisi, Pedagoji Bilgisi ve Teknoloji Bilgisi arasındaki ilişkiyi göz önünde bulundurmaktadır. 6 öğretmen adayından toplanan ders planları ve staj okullarında sundukları dersler de kanıtlamıştır ki öğretmen adaylarının gelişen Teknolojik Pedagojik Alan Bilgileri planlarına ve sundukları derslere yansımaktadır.

Kısacası, çalışmadan elde edilen veriler göstermektedir ki teori ile pratiği birleştiren, Teknolojik Pedagojik Alan Bilgisi Modeli ve Teknolojiyi Tasarım Yolu ile Öğrenme Yaklaşımına dayalı bir tasarım çalışma modeli, üniversiteler tarafından öğretmen adaylarına teknolojiyi alan derslerine etkili bir biçimde entegre etmeleri için gerekli bilgi ve beceriyi kazandırmada kullanılabilir.

CHAPTER I

INTRODUCTION

1.1. Background to the Study

The expanding use of computers has led to changes in the nature of education in the 21st century. All spheres of education have been influenced by this phenomenon and there has been increasing interest in the application of computers and computer-related technology in the classroom (Peterson, 2004). As new advanced technologies have entered the classrooms, there is an increased interest in the essential roles and qualities of teacher knowledge bases necessary for successful technology integration.

The issue of what teachers need to know about technology for effective teaching has been the centre of intense debate in the recent past (Zhao, 2003). Elaborating upon the work of Schulman (1986), who proposed pedagogical content knowledge (PCK) referring to the intersection of subject-specific knowledge, pedagogical knowledge, and knowledge of the teaching context, Koehler and Mishra (2005) have proposed a framework to define the knowledge teachers need to acquire in order to effectively integrate technology into learning. The framework of Technological Pedagogical Content Knowledge (TPACK, changed from TPCK, [Thompson & Mishra, 2007]) consists of three main components of knowledge: content, pedagogy and technology and interactions among them, represented as pedagogical content knowledge (PCK), technological content knowledge (TCK), technological pedagogical knowledge (TPK) and technological pedagogical content knowledge (TPACK). It describes "how teachers' understanding of technologies and pedagogical content interact with one another to produce effective teaching with technology" (Koehler & Mishra, 2008, p. 12). It refers to the complex interrelationship between a teacher's technology use, instructional methods, and understanding of the subject matter (Mishra & Koehler, 2006).

Changes in the field of education over the last three decades have affected the conceptualization and practice of learning and teaching second and foreign languages as well as the body of knowledge that teachers need to promote successful language learning of their students (van Olphen, 2008). He suggested that the foundation of effective integration of technology in language teaching requires the following: an understanding of the ways linguistic and cultural concepts can be represented using technology; educational approaches to language teaching drawing from socio-constructivist philosophies for the development of students' language and cultural competence; an awareness of the factors facilitating or hindering the language acquisition process and the development of language competence and how technology helps students with common problems they ordinarily face; an awareness of students' previous knowledge, especially, a knowledge of second language acquisition and cognitive development theories; and finally "an understanding of how current and emerging technologies can be used to advance present knowledge and to develop new epistemologies and sustain previous ones" (2008, p. 117).

According to van Olphen, TPACK offers a conceptual foundation for language teacher education programs which envision pedagogically meaningful integration of technology. He stresses the need for teacher education programs to prepare language teachers "to opt for, adapt, implement, and even design meaningful technology based activities that are aligned with current approaches to language learning and teaching" (p. 117).

1.2. The Statement of the Problem

Most of the research on the use of technology in language teaching education has focused on the learners and their learning, i.e., how technology affects the learning and teaching processes (van Olphen, 2008). However, not much attention has been devoted to the

knowledge development of future teachers as they learn to integrate technology into their teaching.

As pre-service teachers (PTs hereafter) have not learned their subjects in a technology integrated way, they do not know how to learn their content by using these technologies (Niess, 2008). As mentioned in Niess, "How a person learns a particular set of knowledge and skills, and the situation in which a person learns, become a fundamental part of what is learned" (Putnam & Borko, 2000). Teacher education programs play a vital role in preparing future teachers to become proficient in the integration of technology into the curriculum. Teacher education programs need to help PTs understand how technology can be used to teach content in rich and meaningful ways (Keating & Evans, 2001). However, teacher preparation programs do not currently provide PTs with the kinds of experiences necessary to prepare them to use information technology effectively in their future classroom practice (Duran, 2000; Moursund & Bielefeldt, 1999).

During their teacher education program, "because of lack of technology-trained faculty, many pre-service teachers do not have an opportunity to see teaching with technology modelled" (Medcalf-Davenport, 1999, p. 1424). In addition to the lack of instructional models, during their teacher education program, most PTs are offered technology-specific courses to develop their basic computer skills, such as word processors, email, basic web development, and Internet searches (Hargrave & Hsu, 2000). However research indicated that that these stand-alone courses do not prepare teachers to use technology in a variety of instructional settings as they lack exposure to appropriate models of computer use in content-area specific classroom settings (Mehlinger & Powers, 2002).

Several recommendations have been made to establish the need for technology integrated methods courses. While there are a number of studies showing examples of teacher education programs having implemented instructional technology in ways that encourage

integration, little attention has been paid to PTs' experiences in teaching with technology in the field. It has been observed that PTs are often not exposed to any technology use during their practicum (Medcaff-Davenport, 1999). In other words, PTs do not routinely use technology during field experience and do not work under master teachers and supervisors who can advise them on technology use (Brent et al, 2002; Russell, et al., 2003). Despite the lack of technology integration during field experiences, PTs' use of technology throughout their teacher education experiences have been found to be the most significant predictor of their use of technology in later classroom practice (Brent et al., 2002; Snider, 2003).

One of the foremost challenges for contemporary educators is acquiring proficiency with instructional technology and the conceptual frameworks that support its meaningful integration into classroom practice (DeGennaro, 2008; Keeler, 2008; Schrum & Levin, 2009). Without the experience and expertise needed to effectively engage with technology, pre-service and practicing teachers, if they use technology at all, tend to use it in superficial, low-level ways (Doering & Veletsianos, 2008). The resultant absence of meaningful technology integration in classrooms has led to a disconnect between the current generation of students who have spent their formative years immersed in technology (digital natives), and their teachers (digital immigrants) whose experience with and knowledge of the digitized world may be underdeveloped (Prensky, 2001).

1.3. Significance of the Study

Based on the discussions above, it can be concluded that technological knowledge has become another important category of the knowledge base of teaching, and any attempt to integrate technology in the teaching-learning environment creates a need for developing TPACK. However, while there has been discussion and understanding of what teachers of various subjects such as mathematics, science or English need to know in order to teach their

subject matter with technology (Mishra & Koehler, 2006; Niess, 2005; VanOlphen, 2008), the existing literature offers little insight into how they develop this knowledge.

Teacher preparation method courses are typically organized to help PTs gain effective teaching methods and strategies while carefully considering the students' background knowledge and experiences, the school environment, and the learning goals in the curriculum. These method courses provide a foundation upon which PTs build their developing knowledge about teaching and learning (Niess, 2008). "With conscious attention to the development of TPACK as a way of thinking, methods courses potentially establish environments for engaging pre-service teachers in integrating their developing understandings of content, teaching, and learning along with a conscious consideration of the integration of technology in the learning environment" (p. 227). Methods courses enhanced to support the development of TPACK should involve PTs in changing their mindsets and behaviours established from their own personal learning experiences when learning to plan, organize, critique, and abstract for their specific content, specific student needs and specific classroom situations.

When teacher education programs are considering strategies that will provide opportunities for PTs to develop TPACK, the process of constructing knowledge by developing schemes through actions and experiences should be considered. Koehler and Mishra (2005) have argued that meaningful integration of technology takes place when teachers develop this kind of knowledge and that one effective way to develop TPACK is through direct experience in the design of technology-enhanced learning.

The design of educational technology represents an authentic context for teachers to learn about educational technology. As design-based activities provide a rich context for learning based on inquiry and revision, they can help teachers develop understanding of how to apply knowledge in real-world practice. The Learning Technology by Design approach

emphasizes learning by doing and requires learners to take control of their learning, thus become active learners (Mishra & Koehler, 2006). Learners in this approach become "practitioners", who do not merely learn about the practice.

Design is both process and product, sensitive to the nature of particular subject matter. Thus, those who are participating in the design process need to rethink about the complex interplay of pedagogy and content, and also affordances of technology to achieve their design goals (So & Kim, 2009). In other words, Learning by Design approach is an effective instructional technique for the development of teachers' understanding of the complex relationships between content, pedagogy and technology and the contexts in which they function (Koehler & Mischra, 2005).

Learning to design lessons encompasses an important content area in methods courses which should be followed by field-based experiences to give PTs the opportunity to test and reflect on their developing ideas and understanding. Integrating technology in their lesson plans requires PTs to integrate what they know about the subject, teaching, student learning and the technologies. The goal becomes for them to design lessons in which they transform the content into a form accessible to the learners (Niess, 2008).

Niess (2008) states that "no matter how marvellous the coursework is in providing them (pre-service teachers) with knowledge about teaching with technology, they must have opportunities to apply this knowledge" (p. 246). Microteaching gives PTs the opportunity to test their developing ideas for establishing technology integrated classrooms (Niess, 2008). The microteaching process in a teacher education program is typically carried out in the following way: the pre-service teacher develops a lesson plan, and then teaches that lesson to a small group of his or her peers, or to a small group of classroom students. The lesson is often videotaped. The PT then reflects on the videotape primarily by focusing on the strengths and weaknesses of the presentation of the content and the pedagogical style. Microteaching

has been shown to be an effective strategy in strengthening pedagogical skills (Metcalf, Hammer, & Kahlich, 1996). However, this type of experience is not with the appropriate student levels, in other words, with real students they would be teaching when they become teachers (Niess, 2008).

Field experiences, one of the most important elements in teacher education programs, provide PTs with the opportunity of teaching in real classroom settings (Metcalf, Hammer & Kahlich, 1996). PTs can understand the relationship between theories learned in university courses and the reality of classroom practice. During their field experiences, the real challenge for PTs is to prepare to teach with technology. Thus, field experiences are very important for the preparation of PTs as means of establishing technology practices they will use in future settings (Strudler, McKinney, Jones & Quinn, 1999). The experience provides a hands-on opportunity for PTs to apply the theoretical knowledge they have learned into lessons they teach during their practicum. In other words, field experiences help PTs develop TPACK by understanding the importance of planning and preparation, and comprehending the complexities regarding technology integration (Niess, 2008).

Although there is a consensus in the literature that PTs should use technology during their practicum (Dexter & Riedel, 2003), teacher preparation programs do not currently provide PTs with the necessary experiences to prepare them to use information technology effectively in their future classroom practice (Moursund & Bielefeldt, 1999).

In order to characterize the development of PTs' knowledge base, the development should be studied in the context of coursework and field experiences. The literature indicates that both coursework and field experiences can be significantly enhanced and improved when there is an explicit attempt to integrate them (Putnam & Borko, 2000; Szabo et al., 2002). However, the literature offers little insight into how teacher preparation programs can develop TPACK through the explicit integration of field experiences and university coursework.

Most of the research on the development of TPACK focuses on the content areas such as science, social studies and mathematics (e.g., Pierson, 1999; Keating &Evans, 2001; Woodbridge, 2004; Niess, 2005). In the context of language teacher education, to the best of this researcher' knowledge, no studies have been conducted which describe the development of TPACK. Therefore, this study will fill the gap in the research by investigating pre-service EFL teachers' development of their TPACK in teaching specific topics in English using technology.

1.4. Purpose of the Study

The present study emphasized the integration of educational theory, i.e., coursework, as well with educational practice, i.e., field experience, in order to develop the PTs' knowledge, skills, and dispositions for teaching English as a foreign language with appropriate technologies in ways that support student learning, in other words, their TPACK. More specifically, the study aimed to examine how a coursework explicitly focusing on the framework of TPACK and designed following Learning Technology by Design approach helped develop the Technological Pedagogical Content Knowledge of Turkish PTs of English who were given the opportunity to apply what they learned in their coursework to their field-experience.

The following research questions guided this study.

1. Will there be a significant change in the TPACK (TK, TCK, TPK and TPACK) of pre-service teachers of English as they participate in a design study?
2. Will pre-service teachers' TPACK be reflected in their instructional practices?

1.5. Overview of Methodology

Twenty-two Turkish pre-service teachers of English, enrolled at the English language teaching (ELT) department of a well-regarded state university in Istanbul, Turkey, participated in this study. The participants were selected as follows: At the time of the study, there were 217 PTs enrolled in the final year of the ELT program. At the end of the first semester of 2009-2010 academic year, all 4th year PTs were given an invitation form (see Appendix A). The form informed PTs about the present study and asked if they were willing to participate. Volunteer PTs were asked to give their names and contact information as well as some information about their practicum schools, i.e., technological facilities available. Fifty- four PTs volunteered but due the limited capacity of the computer laboratory at the research site, 22 PTs were randomly selected as the participants of this study.

For the purposes of the present study, a specific course was designed to be offered in the second term of the fourth year of the 4-year English language teaching program. PTs in the fourth year have already taken two computer courses in their freshman year focusing on the development of basic computer skills, such as word processors, email, spreadsheets and Internet searches.

The course met once each week in the technology lab for a total of three hours per week. All students participating to the study during the current term were informed of the purpose of the research project and that participation was strictly voluntary, in no way affecting the outcome of their grades. They were also informed that all data collected were done so confidentially.

The study lasted 12 weeks and was conducted as follows: In the first week, data for the study were collected and the participating PTs were informed about the study. During the weeks two, three and four, classroom discussion focused on technology and language teaching in general. The concept of TPACK was also introduced to PTs through the use of

slides prepared by the researcher and relevant articles. PTs were asked to read the articles beforehand and participate to the classroom discussions. PTs were also given some small assignments to raise their awareness of TPACK. In the following two weeks (Weeks 5 and 6), PTs were asked to carry out 15 to 20 minutes presentations on recent technological tools of their choice. In their presentations, they were supposed to teach how to use the tool, discuss how it can be used in language teaching, present one or two examples of its use and finally discuss if s/he would use it in their future teaching and justify their answer. During these weeks, PTs were given the assignment of lesson planning. For that assignment, they were asked to pick a unit from the coursebook used in their practicum school, identify the problem(s) related to student learning, focus on one problem and find a solution integrating technology. In the weeks seven and eight, PTs carried out the peer teaching of their lesson plans and received feedback from their peers and their instructor, the researcher herself. Based on the feedback they received, they modified their plans and implemented them in their practicum schools (macro teaching) (Weeks 9 and 10). In Week 11, PTs gathered together to share 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.

For the present study, both quantitative and qualitative data were gathered. For the first research question, in order to explore the development of TPACK and its technology related components, quantitative data came from the adapted version of the Survey of Pre-service Teachers' Knowledge of Teaching and Technology (Schmidt, et al., 2009) which consists of 29 questions referring to the categories of TPACK framework.

For the in-depth analysis of the first research question, six PTs, selected among 22 PTs, were followed throughout the study and their reflections and interviews were used to analyze their TPACK development.

For the second research question, those six PTs were observed in order to see how their TPACK is reflected in their instructional practice, i.e., macro-teaching in the practicum school.

For the analysis of the quantitative data, a Dependent means *t*-test was applied to the scores of PTs obtained from the TPACK survey at the beginning and end of the study to evaluate the effect of the specifically designed course on the TPACK development of PTs.

In order to analyze the data coming from the qualitative sources for the first research question, a qualitative content analysis procedure was used following the steps as suggested by Koehler, Mishra, & Yahya, (2007): First, representative samples of communication were identified. Second, a protocol was created for identifying and categorizing the target variable(s) based on the theoretical framework of TPACK. Third, once the data was coded along the categories mentioned, first, systematic quantitative analysis of the occurrence of particular categories was conducted to determine the nature and evolution of PT's TPACK. Then, narratives describing parts of the data rich in thematic information were created.

The aim of this analysis was to investigate whether PTs treated content, pedagogy, and technology as isolated concepts or did they recognize the intertwined relationship between these three knowledge bases and to observe if there was any change as the study progressed and ended.

In order to answer the second research question, lesson plans and observational data of the six cases were analyzed using the Technology Integration Observation Instrument, developed by Harris, Grandgenett, and Hofer (2010), in order to see how PTs' TPACK is reflected in their instructional practices.

1.6. Hypothesis

The hypotheses of the study were as follows:

1) There will be a significant change in TPACK (TK, TCK, TPK, and TPACK) of pre-service teachers of English as they participate in a design study.

2) Pre-service teachers' TPACK will be reflected in their instructional practice.

1.7. Operational Definitions

Pre-service teacher: A university student who participates in a teacher-preparation program to practice and learn the methodology and skills of teaching.

Field experience/practicum: The period of time the student teacher spends in the school under the supervision of the cooperating teacher to learn, develop and practice teaching skills.

Technological Pedagogical Content Knowledge (TPACK): The kind of knowledge referring to the complex interrelationship between a teacher's technology use, instructional methods, and understanding of the subject matter (Mishra & Koehler, 2006).

Content Knowledge (CK): It refers to subject-area knowledge.

Pedagogical knowledge (PK): It is the knowledge about teaching and learning processes and practices and it includes educational purposes, goals, values, strategies, and more (Koehler & Mishra, 2008).

Technology Knowledge (TK): It refers to one's ability to use standard technologies such as books and chalk and blackboard, as well as more advanced technologies such as the Internet and digital video (Koehler & Mishra, 2008).

Pedagogical Content Knowledge (PCK): It represents "the blending of content and pedagogy into an understanding of how particular topics, problems or issues are organized,

represented and adapted to the diverse interests and abilities of learners, and represented for instruction (Schulman, 1987, p. 8).

Technological Content Knowledge (TCK): It is defined as "an understanding of the manner in which technology and content influence and constrain one another (Koehler & Mishra, 2008, p. 16).

Technological pedagogical knowledge (TPK): It refers to the understanding the change that occurs in teaching and learning when particular technologies are used (Koehler & Mishra, 2008).

1.8. The Organization of Chapters

This dissertation consists of five chapters. In Chapter I, a brief background of the study is presented. The statement of the problem, the significance of the study, the purpose, overview of methodology, hypothesis and operational definitions are also included here.

Chapter II presents a review of the literature in terms of the following basic components: (a) teacher knowledge, (b) research on teacher knowledge, (c) a framework for teacher knowledge for technology integration, (d) the TPACK framework.

Chapter III presents the methodology of the study; the research design, a detailed description of the setting, subjects, the treatment, methods of data collection and data analysis of the study.

Chapter IV presents the findings of the study.

Finally, Chapter V provides a discussion of the findings and their implications for pre-service teacher development in EFL teacher education abroad and in Turkey.

CHAPTER II

LITERATURE REVIEW

2.1. Teacher knowledge

Teaching is a complex activity and "investigating the knowledge that teachers possess is critical to understanding the complexities of teaching" (Sherin, Sherin, & Madanes, 2000, p.357). In the last two decades, a great deal of research has been conducted to explore teacher cognition, the nature of teacher knowledge, and teachers' thought processes in general education, second language education, and applied linguistics fields (Borg, 2003; Freeman, 2002; Johnston & Goettsch, 2000; Meijer, Verloop & Beijard 2001; Shulman, 1987). It has been revealed that what teachers know and how they express their knowledge determines their classroom performance; therefore, teacher knowledge research may contribute to the development of a theoretical knowledge base for teaching practices.

Various definitions of teacher knowledge have been offered in the literature. Fenstermacher (1994) defines teacher knowledge as the "ideas, conceptions, images, or perspectives when performing as teachers" (p. 31). Fradd and Lee (1998) conceptualize teacher knowledge as "the repertoire of knowledge, skills, and dispositions that teachers require to effectively carry out classroom practices" (pp. 761-762). In Borg's (1999) definition, teacher knowledge refers to "the beliefs, knowledge theories, assumptions, and attitudes that teachers hold about all aspects of their work" (p. 9). According to Verloop, Van Driel, and Meijer (2001), teacher knowledge refers to the total knowledge and insights underlying teachers' actions in practice. Teachers' knowledge is "accumulated knowledge about the act of teaching, including the goals, procedures, and strategies that form the basis for what teachers do in the classroom" (Mullock, 2006, p. 48). Common to all definitions is

the personal and multidimensional nature of teacher knowledge implying the importance of focusing on its development and interaction with teacher actions and behaviours in practice.

Teacher knowledge was categorized by several authors in different ways. One of the earliest models was suggested by Elbaz (1983) who referred to teacher knowledge as 'practical knowledge' and categorized it into five components as knowledge of self, knowledge of the milieu of teaching, knowledge of subject matter, knowledge of curriculum development, and knowledge of instruction. Elbaz (1983) views knowledge of self, knowledge of the milieu of teaching, and knowledge of subject matter as static knowledge while he considers knowledge of curriculum development, and knowledge of instruction as knowledge bases developing with teaching experience.

In 1986, a new categorisation of teacher knowledge and its components was offered by Lee Shulman who argued that the relationship between "teachers' cognitive understanding of subject matter content" and "the instruction they provide for students" should be the focus of study in educational research (1986a, p. 25). He called for the study of three types of content understandings and their impact on classroom practice: subject matter knowledge, pedagogical knowledge, and curricular knowledge. In his later work, Shulman (1986b) renamed the constructs as subject matter knowledge, curricular knowledge, and pedagogical content knowledge. Of these, pedagogical content knowledge (PCK) has received considerable interest in both research and practice and it was described by Shulman as "the most useful forms of (content) representation…, the most powerful analogies, illustrations, examples, explanations, and demonstrations- in a word, the ways of representing and formulating the subject that makes it comprehensible for others" (1986, p.9).

In 1987, PCK was listed by Shulman as one of seven knowledge bases for teaching: content knowledge (i.e., the knowledge of the content of a subject discipline, involving the major facts and concepts in that discipline and their relationships) , general pedagogical

knowledge (i.e., knowledge of principles and skills of teaching and learning that are generally applicable across subject disciplines), curricular knowledge (i.e., knowledge of the programs and available teaching materials designed for particular topics at a given level) , knowledge of learners (i.e., knowledge of learners' backgrounds, characteristics, particular strengths, weaknesses, and motivation), knowledge of educational contexts, and the knowledge of the philosophical and historical aims of education. PCK as one of the seven knowledge bases, was defined as:

> That special amalgam of content and pedagogy that is uniquely the province of teachers, their own special form of professional understanding… Pedagogical content knowledge…identifies the distinctive bodies of knowledge for teaching. It represents the blending of content and pedagogy into an understanding of how particular topics, problems or issues are organized, represented, and adapted to diverse interests and abilities of learners, and presented for instruction. Pedagogical content knowledge is the category most likely to distinguish the understanding of the content specialist from that of the pedagogue (Shulman, 1987, p. 8).

In other words, pedagogical content knowledge is the intersection of subject-specific knowledge, pedagogical knowledge, and knowledge of the teaching context (Schulman, 1987). PCK describes the understanding of how specific topics, problems, or issues are organized, represented, and adapted to learners with diverse interests and abilities, and how the results of such understanding can be implemented in a classroom. For each topic within a subject, teachers must understand what main concepts, skills, and attitudes should be taught, what parts will be difficult for students, what topics or concepts the students have previously learned, and what teaching methods are appropriate (Shulman, 1987).

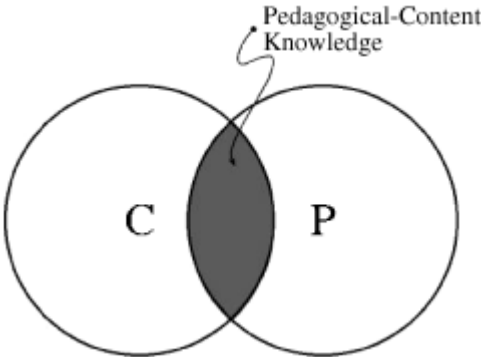

Figure 1. Pedagogical Content Knowledge (adopted from Mishra & Koehler, 2006).

In relation to PCK, Shulman (1987) introduces the concept of "pedagogical reasoning" as being in the centre of teaching and gives the following definition:

> The key to understanding the knowledge base of teaching lies at the intersection of content and pedagogy, in the capacity of a teacher to transform the content knowledge he or she possesses into forms that are pedagogically powerful and yet adaptive to the variations in ability and background presented by the students (p. 15).

In short, according to Shulman, transformation occurs as the teacher interprets the subject matter, finds multiple ways to represent it, and adapts and tailors the instructional materials to students' prior knowledge and alternative conceptions. Without such transformation, teachers' knowledge and understandings will remain tacit and unavailable for teaching.

Shulman states that the process of transformation consists of the following: *preparation* (i.e., critical interpretation and analysis of texts, structuring and segmenting, development of a curricular repertoire, and clarification of purposes); *representation* (i.e., use of representational repertoire that includes analogies, metaphors, examples, demonstrations, explanations, and so forth); *selection* (i.e., choice from among an instructional repertoire that includes modes of teaching, organizing, managing, and arranging); *adapting and tailoring to student characteristics* (i.e., consideration of conceptions, preconceptions, misconceptions,

and difficulties; language, culture, and motivations; and social class, gender, age ability, aptitude, interests, self-concepts, and attention) (p. 15).

Various scholars, elaborating on Shulman's work, have proposed different conceptualizations of PCK to explain its nature (e.g., Abell, 2008; Cochran, DeRuiter, & King, 1993; Grossman, 1990; Magnusson, Krajcik, & Borko, 1999; Marks, 1990).

In her model, Grossman (1990) expanded upon Shulman's ideas and suggested four general areas of teacher knowledge: general pedagogical knowledge, subject matter knowledge, pedagogical content knowledge, and knowledge of context. In her model, "general pedagogical knowledge" includes knowledge and beliefs concerning learning and learners; knowledge of general principles of instruction; knowledge and skills related to classroom management; and knowledge and beliefs about the aims and purpose of education. "Subject matter knowledge" is composed of two elements: the content of the subject area and the knowledge of the structures of a subject. Grossman (1990) defined "pedagogical content knowledge" as having knowledge of representations and strategies for teaching specific topics, student' understanding and conceptions, curriculum and curriculum materials available for teaching, and purposes for teaching specific topics at different grade levels. PCK in Grossman's model is at the heart of teacher knowledge surrounded by knowledge of subject matter, general pedagogical knowledge and contextual knowledge and has the greatest effect on teachers' classroom actions. In her model, Grossman stated that teachers needed PCK to formulate "appropriate and provocative representations of the content to be learned" (p. 8). Lastly, "knowledge of context" is considered as one of the essential components of teachers' knowledge, allowing teachers to adapt to specific students and the demands of school districts.

Marks (1990) also broadened Shulman's model by including four main components in his conceptualization of PCK: (1) subject matter for teaching purposes; (2) students'

understanding of the subject matter; (3) media for instruction in the subject matter (i.e., textbooks, materials); and (4) instructional processes for the subject matter. For him, the development of PCK was a process of integrating the interpretation of subject-matter knowledge and general pedagogical knowledge.

In the model of Cochran, Deruiter and King (1993), PCK was renamed as pedagogical content knowing (PCKg). They defined it as "a teacher's integrated understanding of four components of pedagogy, subject matter content, student characteristics, and the environmental context of learning" (Cochran et al., 1993, p. 266). In their model, they focused on the difference between knowledge and knowing and argued that the term knowledge is too static and inconsistent with the constructivist perspective. Thus, their model was named as Pedagogical Content Knowing to indicate the dynamic nature of knowledge development. Their conceptualization of PCKg emphasized that teachers need to develop their pedagogical knowledge and subject matter knowledge in the context of two other components of teacher knowledge, i.e., teachers' understandings of students, and environmental context of learning (see Figure 2).

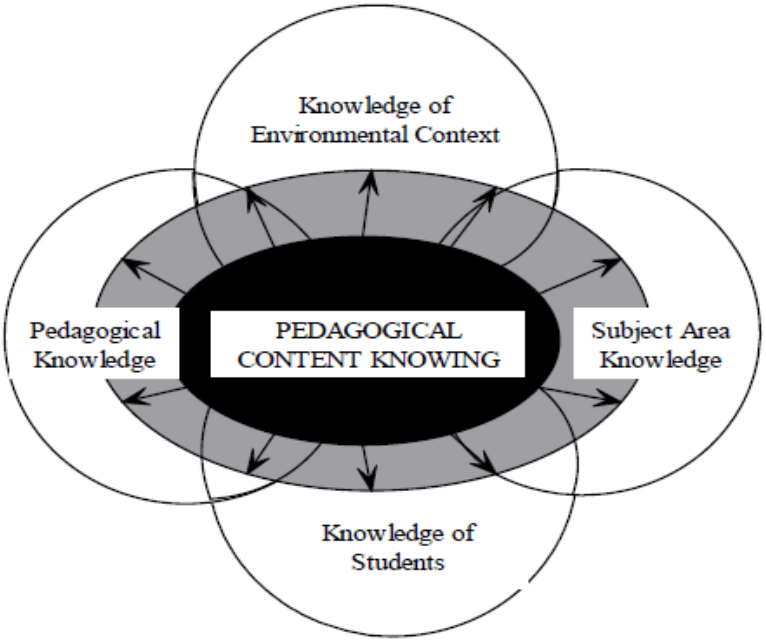

Figure 2. A Model of Pedagogical Content Knowing (PCKg) adopted from Cochran et al., (1993).

Four components of teacher knowledge were suggested by Magnusson, Krajcik, and Borko (1999) in their conceptualization of teacher knowledge: (1) subject matter knowledge, (2) general pedagogical knowledge, and (3) knowledge of context, and (4) pedagogical content knowledge (PCK). They argue that subject matter knowledge, pedagogical knowledge, and knowledge of context strongly influence the pedagogical content knowledge held by the teacher.

In a more recent conceptualization of teacher knowledge, Abell (2008) focuses on PCK and its characteristics and suggests the following: PCK includes discrete categories of knowledge applied during teaching; PCK is dynamic and keeps changing as teachers gain teaching experience; knowledge of subject matter is in the centre of PCK; and PCK supports the transformation of subject matter in a form of knowledge that is comprehensible to students.

What is common to different conceptualization of PCK is that it refers to the knowledge of representations of subject matter and instructional strategies incorporating these representations and understanding of specific student conceptions and learning difficulties, both with respect to a specified content area.

2.2. Research on teacher knowledge

Earliest research on teacher knowledge, in 1970s, when product-process research paradigm was followed, focused on exploring teachers' teaching behaviours in the classroom and how they affected students' learning outcomes. In the late 1970s and 1980s, research on teacher knowledge shifted from focusing on behaviours to interest in cognition (Verloopi Van Driel, & Meijer, 2001). Studies were conducted to learn about the thinking processes of teachers as they planned and how their thinking affected and shaped the way they taught (Freeman & Johnson, 1998; Shulman, 1992). Research following this paradigm considered teaching as a highly complex and context-specific activity; thus investigated the teachers' thinking and how they learn to teach (Freeman, 2002). 1990s and 2000 is referred to as the "decade of consolidation" by Freeman (2002, p. 8) and research on teacher's knowledge and learning to teach focused on deeper understandings of the role and nature of teachers' mental lives by bringing the voices of teachers into the research project (Freeman, 2002; Tsui, 2003)

Research conducted on teacher knowledge, in general, aims at developing a knowledge base of teaching which formed the basis of teachers' behaviour (Hoyle & John, 1995). Developing such a knowledge base "may contribute to the development of a theoretical knowledge base for teaching practices, and as a consequence to establishing a systematic relation between theory and practice so that practice can be controlled by, rather than control, teachers" (Carlgren & Lindblad, 1991, p. 515). Therefore, findings of research

on teacher knowledge form the basis of teacher education practices as they improve the understanding of teaching and learning how to teach (Cole & Knowles, 2000).

There exits a significant body of research on teacher knowledge, particularly on PCK, in the fields of science and mathematics. However, in the field of English language teaching (ELT), these studies are very limited in number. Few studies conducted with language teachers and pre-service teachers focused on identifying their knowledge base and the background sources influencing its development (e.g., Borg, 1998 & Freeman & Richards, 1996).

2.2.1. Second/foreign language teacher knowledge.

Studies on second/foreign language (L2) teacher knowledge have mostly focused on the background sources influencing the development of the knowledge. Three main sources were identified: Teachers' prior experiences as language learners (e.g., Borg, 1998; Meijer et al., 1999; Numrich, 1996; Peacock, 2001), their teaching experiences (e.g. Akyel, 1997; Gatbonton, 1999, 2008; Richards, 1998; Wu, 1995) and L2 teacher education (e.g. Borg, 1998; Grossman, 1989, 1990).

A number of studies have shown that during their 'apprenticeship of observation' (Lortie, 1975), pre-service teachers begin to form their beliefs about language learning and these beliefs form the basis of their teaching beliefs as they start their teaching career (Mullock, 2006). In his study with twenty-six novice ESL teachers, Numrich (1996) found out that teachers' prior language learning experiences as a language learner influenced their instructional decisions in their L2 teaching. Teachers were reported to be using the methods and techniques they found useful from their own language learning experiences. In his case study with an EFL teacher, Borg (1998) investigated how the previous learning experiences of the participating teacher affected his teaching and concluded that the teacher transferred the

strategies and teaching methods that he experienced as a learner into his teaching. Peacock (2001) investigated how perservice teachers acquired their belief systems and found out a powerful influence of their previous schooling experience on their beliefs. The study showed that after three years of education in an ESL program, many of the participating preservice teachers kept their original beliefs to a great extent. For example, communicative activities were not recognized by them as learning a second language meant learning a large number of vocabulary items and grammar rules, which was a belief formed based on their previous language learning experiences.

Some studies were also conducted to examine how teachers' teaching experiences influence their knowledge. Wu (1995) compared the teaching processes of senior high school expert and novice teachers and found out some differences in terms of the strategies used while teaching, ways of motivating students, teaching language skills and teaching effectiveness. The findings revealed that expert teachers were more flexible, focused on teaching of four language skills rather than focusing on test-oriented teaching, and arouse students' motivation through the use of encouragement rather than the use of reprimands as novice teachers did. In her study comparing experienced and novice ESL teachers, Akyel (1997) found that experienced teachers considered a more varied range of instructional options when responding to student cues whereas novice teachers interpreted learners initiations as obstacles and rather focused on maintaining the flow of instructional activities. Richards et al. (1998) compared ten student teachers with little teaching experience and ten experienced teachers in terms of their planning a reading lesson. They found that inexperienced teachers, compared to the experienced ones, used limited lesson plans, planned a teacher-fronted lesson, had limited range of objectives, saw limited teaching potential in the text and presented a narrow view of reading. In her study with two groups of experienced ESL teachers, Gatbonton (1999) aimed to investigate what patterns of pedagogic thoughts

experienced L2 teachers used. She found 21 categories of pedagogical thoughts such as Language Management, Knowledge of students, Procedure Check, or Progress Review, Beliefs. The number of categories and their rank ordering in terms of frequency were similar for these two groups of teachers who taught similar courses a year apart. According to Gatbonton, the reason of these similarities were the similar experiences that the teachers had, i.e., at least ten years of teaching experience and five years of teaching based on communicative language teaching.

In 2008, Gatbonton conducted a similar study and investigated the pedagogical knowledge of four novice ESL teachers. The aim was to compare new findings about novice teachers to the findings about experienced teachers in the previous study to see whether differences in the number of years of teaching experience could be the reason of the differences between novice and experienced teachers. The findings revealed the following differences between experienced and novice teachers: Experienced teachers were more aware of students' classroom behaviour, could detect whether students were listening to the lesson, and they acknowledged students' positive reactions to classroom events. On the other hand, novice teachers focused on students' negative reactions.

Studies have also revealed that teacher education can influence L2 teacher knowledge. For example, in her study with six secondary English teachers, Grossman (1989) studied the different approaches to teaching by comparing three teachers who had been through formal teacher training and three teachers who had participated in alternative certificate courses without pedagogical emphasis. The findings revealed differences in terms of their conceptualizations of what content to teach, purposes of teaching English and their understanding of students' learning. Teachers who did not have teacher education coursework "found it difficult to re-think their subject matter for teaching" (p. 30). She concluded that subject specific coursework in a teacher education program that that teachers received

influenced their PCK by providing them a framework shaping their thinking and approaches to ELT. Similarly, in his later study, Grossman (1990) compared teachers who went through teacher preparation with teachers who did not and found out teacher education received contributed to differences in content knowledge of the teachers. Borg (1998) also found that teacher training courses mark an influence on the pedagogical systems of experienced EFL teachers.

Based on these research findings conducted in the field of second/foreign language teaching, it can be concluded teachers' language learning experiences, their teaching experience, and their professional coursework have been found to influence the development of their knowledge base.

2.3. A Framework for Teacher Knowledge for Technology Integration

Technology has become a significant aspect of life in the 21st century. It has fundamentally changed the way people communicate and the way they do their business. The expanding use of technology has also led to the changes in the nature of education. 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 (Peterson, 2004).

The ongoing emergence of new classroom technologies, such as computers, projectors, interactive white boards, the Internet, and educational software continue to change educational environments by providing new opportunities for students to use these classroom technologies and teachers to create technology-enhanced teaching and learning environments (Brill & Galloway, 2007). 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.

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) state 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.

As mentioned before, according to the PCK framework of Shulman (1987), a blending of content and pedagogy represents how particular topics are organized for learners. For a new curriculum area such as technology, this presents particular challenges for teachers as they search to construct a coherent, technological content base and appropriate assessment practices.

The lack of theory and conceptual framework to inform researchers in effective technology integration has been mentioned as a major weakness in the educational technology literature by many authors. (Angeli & Valanides, 2005; Margerum-Rays & Marx, 2003; Niess, 2005; Mishra & Koehler, 2006). In view of recognizing the lack of theoretical frameworks to guide teacher preparation in technology integration, researchers have proposed a number of theories and frameworks in order to guide research in the area of teacher knowledge about technology integration and to inform teacher preparation in technology

integration (e.g., Angeli and Valanides, 2005; 2008; Margerum-Rays & Marx, 2003; Mishra & Koehler, 2006; Keating & Evans, 2001; Niess, 2005; Pierson, 2001). These researchers advocate that teachers need to develop a new body of knowledge that constitutes an extension of Shulman's (1986, 1987) PCK into the domain of teaching with technology.

A few conceptions of how to extend PCK in the domain of teaching with technology exist in the literature with different labels such as PCK of educational technology by Margerum-Leys and Marx (2003), ICT-related PCK by Angeli & Valanides (2005), and Technological Pedagogical Content Knowledge by Pierson (1999, 2001), Keating and Evans (2001), Niess (2005) and Mishra and Koehler (2005, 2006, 2007).

Margerum-Leys and Marx (2003) focused on the notion of PCK of educational technology. In their model, content knowledge of educational technology referred to the knowledge of how to use technological tools, knowledge of their affordances and general technical skills. They defined pedagogical knowledge of educational technology as the application of general pedagogical strategies such as how to scaffold students' thinking, how to motivate them or how to check their comprehension. PCK of educational technology was defined as the knowledge teachers gain from and use in the teaching and learning situations in which educational technology is used.

ICT-related PCK was proposed by Angeli and Valanides (2005) to account for the phenomenon of teachers' learning how to teach with technology. It was conceptualized as the knowledge that makes teachers competent to teach with technology and as the ways in which knowledge about tools are synthesized into an understanding of pedagogy, content, learners, and context. Later, they referred to their conceptualization as Technological Pedagogical Content Knowledge (TPCK) (Angeli & Valedines, 2008) and stated that "at the heart of this conceptualization is the view that technology is not a delivery vehicle that simply delivers information, but a cognitive partner that amplifies or augments student learning" p. 14). Based

on several investigations, they concluded that "TPCK is a distinct body of knowledge that can be taught, and thus, assessed" (p. 13). As shown in Figure 3, their TPCK included (a) subject-matter knowledge, i.e., the understanding of the content domain; (b) pedagogical knowledge, i.e., principles and strategies of teaching, classroom management and organization that may differ depending on the content domains; (c) knowledge of learners, i.e., the characteristics and pre-conceptions of learners brought to a learning situation; (d) knowledge of context, i.e., the classroom atmosphere, the educational values and goals, and teachers' epistemic beliefs about teaching and learning, and (e) technology knowledge, i.e., knowing how to use technological tools.

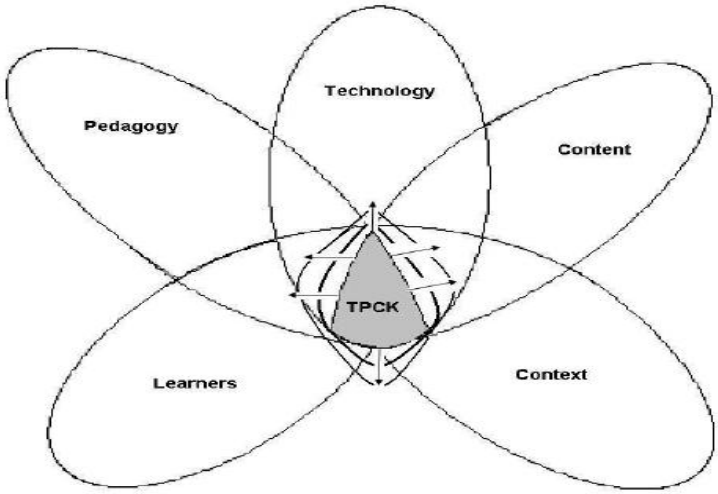

Figure 3. TPCK (adopted from Angeli & Valadenes, 2005).

The concept of TPCK was formally introduced by Pierson (1999, 2001) prior to Koehler and Mishra (2005). In her study, she suggested the component of technological knowledge to the model of PCK and she emphasized that "this knowledge would include not only basic technology competency but also an understanding of the unique characteristics of particular types of technologies that would lend themselves to particular aspects of the teaching and learning processes" (p. 427). According to her, for effective technology integration

teachers should be able to use their extensive content knowledge and pedagogical knowledge in combination with technological knowledge. She adds that "the intersection of the three knowledge areas, or technological-pedagogical-content-knowledge, would define effective technology integration." The following figure introduces her model of TPCK.

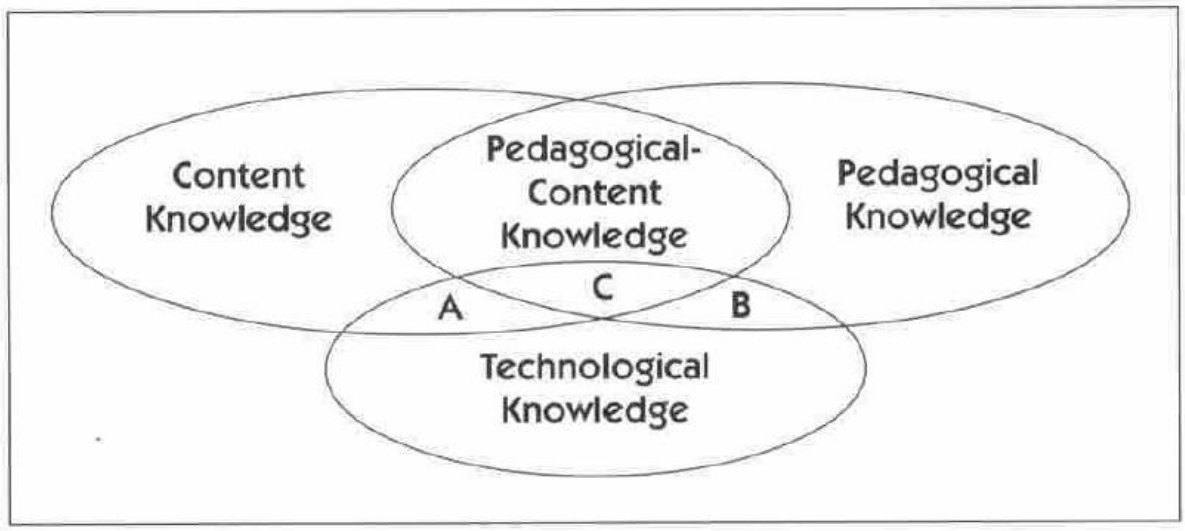

Figure 4. Relationships among content, pedagogical, and technological knowledge (adopted from Pierson, 1999) .

Other investigations into the concept of technological pedagogical content knowledge include the work of Keating and Evans (2001). They indicated that "technological pedagogical content knowledge extends beyond proficiency with technology for personal use to an understanding of how technology can be integrated with subject matter and the technology itself.… The teacher understands the…inevitable challenges that accompany any new technology." (2001, p. 2). Their concept of TPCK involved the teacher making "judicious" decisions related to the inclusion of new technologies that allow the subject matter to be represented in the most appropriate ways. A teacher that has developed TPCK "understands the effect technology may have on her student's conceptions of the subject, the

extent to which student's use of technology may actually impede understanding of a subject, and the inevitable challenges that accompany any new technology" (2001, p. 161).

In his study, Niess (2005) elaborated on TPCK extending Grossman's (1989, 1990) four central components of PCK. He defined TPCK as the "development of knowledge of subject matter with the development of technology and of knowledge of teaching and learning" and added that "it is this integration of the different domains that supports teachers in teaching their subject matter with technology" (p. 510). His conceptualization of TPCK was based on the following four principles: (1) an overarching conception of what it means to teach a particular subject integrating technology in the learning; (2) knowledge of instructional strategies and representation for teaching particular topics with technology; (3) knowledge of students' understanding, thinking, and learning with technology in a particular subject; (4) knowledge of curriculum and curriculum materials that integrate technology with learning in the subject area (Niess, 2005).

In the present study, the TPCK framework of Mishra and Koehler is followed. The following section will give a detailed account of the TPCK framework as discussed by Mishra and Koehler (2005, 2006, 2007, 2008).

2.3.1. The TPCK framework.

Mishra and Koehler (2006) discusses that a theoretical framework focusing on the relationship between technology and teaching can inform the practice of teacher education, teacher training, and teachers' professional development. The conception of TPCK of Mishra and Koehler has developed over time through a series of publications (e.g., Koehler, Mishra, Hershey, & Peruski, 2004; Koehler & Mishra, 2005a; 2005b; Mishra & Koehler, 2006; Koehler, Mishra, & Yahya, 2007). Their framework of Technological Pedagogical Content Knowledge (TPCK) describes "how teachers' understanding of technologies and pedagogical

content interact with one another to produce effective teaching with technology" (Koehler & Mishra, 2008, p. 12). The updated version of the acronym of TPCK was introduced by Thompson and Mishra (2007) as TPACK. They discuss that "A" in the acronym TPACK better represents the interdependence of the knowledge domains of technology, pedagogy and content, thus the framework better explains the "Total PACKage" of teacher knowledge (TPACK hereafter).

PCK constitutes the conceptual basis for Mishra and Koehler's (2006) construct of TPACK which is conceptualized as a situated form of knowledge deeply rooted in the interactions of subject matter, pedagogy, and technology. TPACK is described by Mishra and Koehler (2006) as a framework for teacher knowledge for technology integration and its development is seen as crucial for effective technology integration. In the "Handbook of Technological Pedagogical Content Knowledge (TPCK) for Educators" (2008), Koehler and Mishra discuss that they emphasize teacher knowledge because it is the teacher as 'an autonomous agent' who integrates the technology into his/her teaching appropriately or inappropriately.

Mishra and Koehler (2006) state that technology was not discussed in the PCK framework of Shulman because technology was not used or discussed as commonly as today. They mention that a variety of technologies such as textbooks, over-head projectors or typewriters are being used in traditional classrooms but they are not regarded as technologies as they have become "transparent." In contrast, today, technology refers to digital computers, artefacts or mechanisms that have not become "transparent" or part of the mainstream yet. They argue that although Shulman's framework is still appealing, what is different today is the availability of digital technologies and demands for learning how to teach with technology. Shulman's defition of PCK emphasized the importance of using "the most powerful analogies, illustrations, examples, explanations and demonstrations" in order to

make the subject-matter "more accessible and comprehensible" to the learner (cited in Mishra & Koehler, 2006). As Mishra and Koehler argue, technologies have a critical role in these aspects mentioned by Shulman by constraining and affording a range of representations, analogies, examples, explanations and demonstrations that help to make content more comprehensible to the learners. It is also stated that the rapid change and development of digital technologies prevents them from becoming "transparent." Teachers today are required to learn new techniques and skills as current technologies become obsolete. This situation contrasts with the earlier conceptualization of teacher knowledge, in which technologies were relatively stable. Thus, teachers could focus on pedagogy and content as they remain static over time and as technology would not change dramatically throughout their teaching career. The new context of teaching, on the other hand, becomes an important aspect of teacher knowledge.

Mishra and Koehler (2006) add that today the problems related to the role of technology knowledge are similar to the problems mentioned by Shulman in 1980s. In 1980, before the idea of PCK was introduced, knowledge of content and pedagogy were considered to be separate and independent from each other. Today, technology knowledge is also considered to be a separate domain of knowledge independent from the knowledge of content and pedagogy. This approach is represented by Mishra and Koehler as follows:

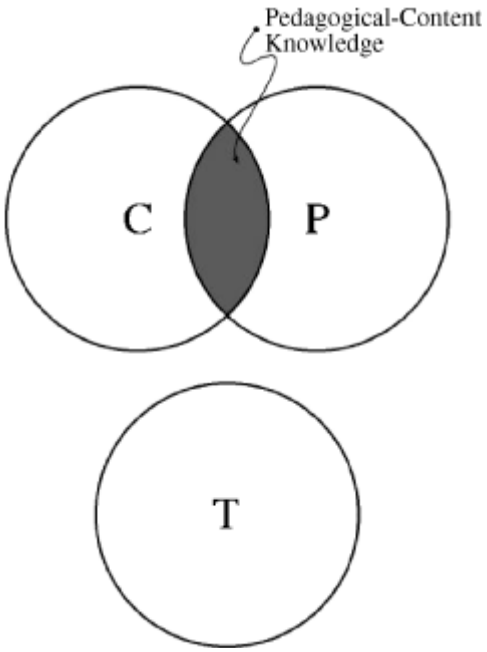

Figure 5. The relationship between content, pedagogy and technology (adopted from Mishra & Koehler, 2006)

As the Figure 5 represents, the relationship between content, pedagogy and technology is viewed to be nonexistent. The reflection of this thought can be seen in the design and implementation of workshops or teacher training programs focusing on the development of technology skills in isolation (Mishra & Koehler, 2006)

However, the relationships between these three knowledge bases are "complex" and "nuanced" (p. 1025). Technology influences the content to be taught and the way it is represented. Thus, it would be inappropriate to view technology in isolation. The TPACK framework, then, emphasizes the connection between these three knowledge bases. What makes the approach of Mishra and Koehler different from the other approaches focusing on the connection between content, pedagogy and technology (e.g., Keating & Evans, 2001; Margerum-Leys & Marx, 2003; Niess, 2005) is "the specificity" of the articulation of the relation between the knowledge domains of content, pedagogy and technology. They do not

only focus on these components in isolation but also in pairs as pedagogical content knowledge, technological content knowledge, technological pedagogical knowledge, and all together technological pedagogical content knowledge.

The TPACK framework is based on the idea that teaching is a complex activity requiring many kinds of knowledge (Mishra & Koehler, 2006). As mentioned in their chapter, they view teaching as "an ill-structured, complex domain" (p. 3). Their discussion of the ill-structured nature of teaching is related to its "high level of variability across situations" and "a dense context-dependent inter-connectedness between knowledge and practice" (p. 4). By referring to a number of authors, they state that teaching as an ill-structured problem does not have a unique, correct or best solution. Thus teachers need to have "a flexible access" and "application of highly organized systems of knowledge" such as the knowledge of students' learning or knowledge of content (p. 4). They add that integrating technology into teaching adds another domain of knowledge into the already complex nature of teaching and this makes things more complicated.

Their definition of technology comes from Wikipedia (2006, cited in Mishra & Koehler, 2006) as "the tools created by human knowledge of how to combine resources to produce desired products, to solve problems, fulfil needs, or satisfy wants" (p. 5). In relation to the general description of technology, they also define educational technology as a collection of tools, techniques and knowledge that is applicable to education. Their definition of educational technology refers both analogue technologies such as chalkboard or pencil and digital technologies such as Internet or blogging and includes newer (e.g., blogs, podcasts) as well as older technological tools (the chalkboard, the pencil).

In relation to technology, Koehler and Mishra discuss *affordances* and *constraints* of particular technologies and claim, by citing Bromley (1998) and Bruce (1993), that this makes particular technologies more suitable for certain tasks. As cited by Koehler and Mishra,

Gibson (1977, 1979) defines affordance as "the perceived and actual psychological properties of any object, as a means of explaining how individuals interact with objects in the world" (p. 5). To exemplify the definition, Koehler and Mishra mention the affordances and constraints of a hammer. They state that the hammer affords hitting objects because of its handle and weighted end while it also constraints possible ways of using it due to its design. For example, you cannot afford "turning a screw" or "designing a website." With the aim of illustrating the application of these two terms to educational technology, the authors give the example of e-mailing. They state that while using email affords "asynchronous communication" and "easy storage of exchanges," it does not afford "the conveyance of subtleties of tone, intent, and mood" (p. 5). Another discussion they have is whether affordances and constraints of particular technologies are "*inherent* to the technology" or are "*imposed from outside* by the user" (pp. 5- 6). They use the term "functional fixedness" from cognitive psychology to refer to the process in which affordances and constraints of technologies are "imposed from outside by the user" and they discuss that it prevents users from using a particular technology in a creative way. They add that this must be overcome for effective integration of technology because "creative uses of technology require us to go beyond this 'functional fixedness' so that we can innovatively repurpose existing tools toward pedagogical ends" (p. 6).

Koehler and Mishra (2008) discuss that, in today's world, for technology integration, usually newer digital technologies are considered. Compared to older and analogue technologies, these preferred technologies are "*protean"* (a term introduced by Papert, 1980, as cited in Koehler & Mishra, 2008) and "*unstable*" and "*opaque*" (a term introduced by Turkle, 1995, as cited in Koehler & Mishra, 2008). These characteristics inherent to the new and digital technologies are discussed by Koehler and Mishra as the reasons why integration of technology makes teaching more complicated.

According to Koehler and Mishra (2008), new and digital technologies are "protean" in nature because they can be used in many different ways. The example given is the digital computer. It can be used for communication, design, construction, inquiry or for artistic expression. However, this strength of a particular technology makes it difficult to learn for its user. This problem is also true for teachers learning about technologies. The second feature of digital technologies is their being "functionally opaque." It refers to the fact that "the inner workings of most contemporary technologies are hidden from those who use them" (p. 8). However, they discuss that, in order to be able to use technologies not intended to use for educational purposes for education, teachers need to work for that "opacity" (p. 8). Finally, it is stated that digital technologies are "unstable", i.e., rapidly changing (p. 8). Due to this feature of digital technologies, teachers, today, are expected to become "lifelong learners who are willing to contend with ambiguity, frustration, and change" (p. 8).

In addition to the characteristics of digital technologies that make teaching more complicated when technology is integrated into it, Koehler and Mishra (2008) also discuss teachers' lack of experience in using digital technologies for teaching. This lack of experience usually results in teachers' feeling not prepared to use technology in their teaching. They state that, for teachers, acquiring relevant skills might be a challenge. By quoting Ertmer (2005, cited in Koehler & Mishra, 2008) they emphasize that if the uses of technology do not match the pedagogical beliefs of teachers, then, they do not make use of the technology related skills they acquire.

Another issue making technology integration more complicated as discussed by Koehler and Mishra (2008) is "the kinds of *social and institutional contexts* in which teachers work" (p. 9, emphasis added). They state that there is a tension between educators and technologists and this tension discourages teachers from effective technology integration.

The final factor complicating the technology integration for teachers is related to

"varied" and "diverse" classroom contexts. They discuss that there cannot be a "perfect solution" for the integration of technology as the subject matter taught and a particular classroom context have an influence on the integration process. They mention two divides related to the context of teaching: the divide between "digital natives" referring to the students growing up with technology and "digital immigrants" referring to the teacher who was introduced to the technology later in his/her life and the "digital divide" between the people with or without an access to the latest technology (Koehler & Mishra, 2008, p. 10).

After listing the factors mentioned above, Koehler and Mishra suggest viewing technology integration as a "wicked problem" by borrowing the term introduced by Rittler and Webber (1973, cited in Koehler & Mishra, 2008). As they discuss, wicked problems are "unique" and "novel." They cannot be solved in a linear fashion and one solution might create another problem. Thus, as technology integration is an example of a wicked problem, "there is no definitive solution to a technology integration problem" (p. 11). More specifically, "there is no general solution to a teaching problem for every context, every subject matter, every technology, or every classroom" (p. 20). In addition, the complexity of the classroom context and the diversity of its participants, i.e., teachers, students, coordinators, etc. add to the wickedness of technology integration creating a need to develop a way of dealing with this complexity (Koehler & Mishra, 2008). They argue that "at the heart of good teaching with technology are three components: content, pedagogy, and technology and relationships between them" and these three knowledge bases "form the core of the TPACK framework" (pp. 11-12).

2.3.1. 1. Content Knowledge.

Content Knowledge (CK) refers to subject-area knowledge. More specifically, it is "knowledge about the actual subject matter that is to be learned or taught" (Koehler &

Mishra, 2008, p. 13). Knowledge of content includes knowledge of concepts, theories, ideas, organizational frameworks, methods of evidence and proof, as well as established practices and approaches toward developing such knowledge in a particular discipline (Shulman, 1986, cited in Koehler & Mishra, 2008). According to Koehler and Mishra, CK across the field shows great differences and it is critically important for teachers to have a comprehensive base of CK of the discipline in which they teach (e.g., Mishra & Koehler, 2006; Koehler & Mishra, 2008).

2.3.1.2. Pedagogical Knowledge.

Pedagogical knowledge (PK) refers to the knowledge about teaching and learning processes and practices and it includes educational purposes, goals, values, strategies, and more (Koehler & Mishra, 2008). Knowledge about teaching techniques and methods, the needs and preferences of the learners, cognitive, social and developmental theories of learning, classroom management, lesson plan development and implementation, and the strategies used for student assessment constitute PK and teachers equipped with PK have an understanding of the different ways students construct their knowledge and acquire skills (Mishra & Koehler, 2006; Koehler & Mishra, 2008).

2.3.1.3. Technology Knowledge.

Technology Knowledge (TK) refers to one's ability to use "standard technologies such as books and chalk and blackboard, as well as more advanced technologies such as the Internet and digital video" (Mishra & Koehler, 2006). Having a TK means a person can accomplish a variety of different technology related tasks such as installing and removing devices, software programs or creating and archiving documents and can develop different

ways of accomplishing a given task (Koehler & Mishra, 2008). Due to the changing nature of technology, TK needs to change as well.

The relationship between each pair of concepts is then identified as pedagogical content knowledge (PCK), technological content knowledge (TCK), and technological pedagogical knowledge (TPK). Emphasis is placed on the "connections, interactions, affordances, and constraints" (Mishra & Koehler, 2006, p. 1025) between and among the three components.

2.3.1.4. Pedagogical Content Knowledge.

Pedagogical Content Knowledge (PCK) refers to the idea that pedagogy and content are interwoven and it is consistent with and similar to Shulman's (1987) idea of knowledge of pedagogy that is applicable to the teaching of specific content (Koehler & Mishra, 2008). It includes the knowledge of students' prior knowledge, different teaching strategies in a particular discipline, representation and formulation of concepts, pedagogical techniques, and what makes concepts difficult or easy, which are essential for effective teaching (Harris, Mishra & Koehler, 2009; Koehler & Mishra, 2008; Mishra & Koehler, 2006).

2.3.1.5. Technological Content Knowledge.

Technological Content Knowledge (TCK) is defined as "an understanding of the manner in which technology and content influence and constrain one another (Koehler & Mishra, 2008, p. 16). While the choice of a certain technological tool affords and constraints the area of content to be taught, the chosen content area focused on also limits the choice of the tool. Teachers need to know how subject matter can be changed by the application of technology. They should also be aware of specific technologies that support subject-matter learning best in their domains and how content dictates specific educational technological

uses, and vice versa (Harris, Mishra & Koehler, 2009; Koehler & Mishra, 2008). For the development of TCK, teachers need to understand that (1) content shapes new technologies or new uses for current technologies while the affordances and constraints of technologies also shape content; (2) technology has an effect on human cognition; and (3) technological changes offer new perspectives for understanding human cognition (Harris, Mishra & Koehler, 2009).

2.3.1.6. Technological pedagogical knowledge.

Technological pedagogical knowledge (TPK) refers to the understanding the change that occurs in teaching and learning with the use of particular technologies. This includes the knowledge of pedagogical affordances and constraints of various technologies as they are used in teaching and learning settings (Koehler & Mishra, 2008). To make their point clear, the authors give the whiteboard example. Whiteboards are usually placed in front of the classroom. Such a placement has got an effect on the role of the teacher, students and the seating arrangement. Teachers usually stand in front of the board controlling its use. Students can use the board only when they are called and chairs or tables face the board. However, the same board might have a very different use in a business meeting where anybody can use it and where the discussion revolves around it. Thus, according to Koehler and Mishra, an important part of TPK is the ability to use technology with creative flexibility to be able to "repurpose" them for teaching purposes.

2.3.1.7. Technological pedagogical content knowledge.

Finally, TPACK is different from knowledge of its individual component concepts and their intersections (Koehler & Mishra, 2008; Mishra & Koelher, 2006). It refers to the complex

interrelationship between a teacher's technology use, instructional methods, and understanding of the subject matter (Mishra & Koehler, 2006). More specifically:

> 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. (Mishra & Koehler, 2006, p. 1029)

In other words, TPACK is not a simple combination of three independent domains; rather, content, pedagogy, and technology are interdependent, each one affecting the others (Harris et al., 2007, see Figure 6).Successful integration of technology "requires continually creating, maintaining, and re-establishing a dynamic equilibrium between each component" (Koehler & Mishra, 2008, p. 20).

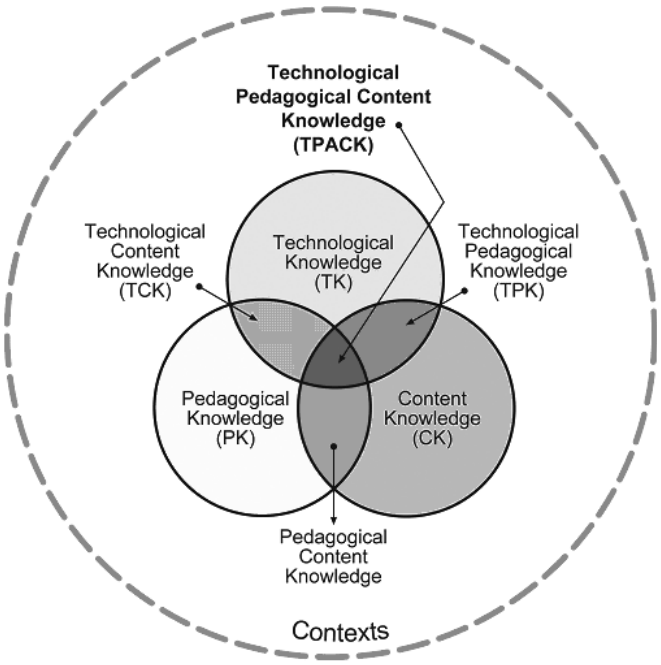

Figure 6. The TPACK Framework and Its Knowledge Components (taken from Harris, Mishra & Koehler, 2009).

As can be seen in Figure 6, TPACK is a unique body of knowledge constructed from its contributing knowledge bases. Mishra and Koehler (2006) state that content, pedagogy and technology "exist in a state of dynamic equilibrium" (p. 1029). In the traditional view of the relationship between these knowledge bases, it was considered that content drove the decisions of pedagogy and technology. In other words, how to teach and which technological tool to use followed the decision of what to teach. However, today, with the new technologies, the driving force became the technology, which reconstructed the dynamic equilibrium among these three knowledge bases. Thus, TPACK is viewed by Mishra and Koehler as knowledge that expert teachers make use of any time they teach. Sometimes the use of this knowledge is not obvious when "transparent" technologies are used. But newer technologies require teachers think about all three components not only technology. "This knowledge would not typically be held by technologically proficient subject matter experts, or by technologists who

know little of the subject or of pedagogy, or by teachers who know little of that subject or about technology" (2006, p. 1029).

2.3.2. The Development of TPACK

How teachers will acquire TPACK has been a focus of research recently. As Mishra and Koehler (2006) discuss, the standard approach has focused on training teachers to use technology, which assumes that teachers can successfully incorporate technology into their teaching if they are proficient in using the current software and hardware. As a result of this approach, a wide range of workshops and teacher education courses have been organized and implemented by policy makers and teacher educators. "This content-neutral emphasis on generic software tools assumes that knowing a technology automatically leads to good teaching with technology" (p. 1031). However, it is agreed by most scholars that this traditional view of technology training cannot help teachers to become "intelligent users of technology for pedagogy."

Koehler and Mishra (Koehler & Mishra, 2005; Mishra & Koehler, 2003) argue that the emphasis on the technology related competencies and "checklists of things" that teachers are required to learn is problematic for the following purposes: (1) Technology changes so rapidly that it is not possible to expect teachers to be updated on the latest software or hardware; (2) Today's most software tools are not originally designed to be used for educational purposes but for business and work; (3) Context-neutral approaches focusing on the integration of technology encourage "generic solutions" to the problem of teaching; (4) Such an approach focuses on "what" teachers need to know rather than "how" teachers are to acquire these skills.

Mishra and Koehler discuss that decontexualized approaches such as single technology courses to technology integration are likely to fail because of their emphasis on

technology skills in isolation without developing technological pedagogical knowledge, technological content knowledge, or technological pedagogical content knowledge. They mean that "merely knowing how to use technology is not the same as knowing how to teach with it" (2006, p. 1033). Instead, Mishra and Koehler propose "Learning Technology by Design" approach in which teachers become curriculum designers to develop their TPACK.

2.3.2. 1. Learning Technology by Design Approach.

Successful technology integration is considered, by Mishra, Koehler and Zhao (2007) as a "sociological issue, intimately connected to institutional cultures and practices, to social groups (formal and informal), and to individual intention, agency and interest" (p. 1). This requires, for teachers, a restructured professional development experience so that "they might develop the kind of nuanced understandings called for in our TPCK framework" (p. 1).

A key component of TPACK is "Learning Technology by Design" approach which is based on "an active engagement with problems of pedagogy." In this professional development approach, teachers, in design teams with individuals of varying levels in expertise in content, pedagogy and technology, develop solutions to authentic pedagogical problems by using technology (Peruski, Mishra, & Koehler, 2007). Mishra and Koehler (2006) argue that the TPACK framework guides curriculum design and helps to create "conceptually and epistemologically coherent learning environments" (p. 1034). According to the authors, design of educational technology provides teachers with an authentic context to learn about educational technology. The design experience helps teachers "build something that is sensitive to the subject matter (instead of learning the technology in general) and the specific instructional goals (instead of general ones)" (Mishra, Koehler & Zhao, 2007, p. 9).

Mishra, Koehler and Zhao (2007) list the principles that guided the development of Technology by Design Approach as follows:

> *Principle 1:* Teachers' ability to use technology must be closely connected to their ability to teach; that is, good-teachers-with-technology must be good teachers.
>
> *Principle 2:* The most effective environment for teachers to learn to teach with technology is one that provides ample opportunities to engage in authentic uses.
>
> *Principle 3:* The implementation of technology is the reinvention of technology. The realization of technological potential in educational settings is socially constructed and highly situational. Therefore, teachers should actively participate in the construction and reinterpretation of technology in their own teaching within visible community of practice and inquiry that is both dedicated to and engaged in standards-based teaching and learning.
>
> *Principle 4:* The relationship between technological innovation and established educational practices is dialogical. Technological innovation pushes pedagogical change, but it is also selected and redefined by existing pedagogy. Technological innovation should be anchored in thoughtful pedagogical practices while serving as a catalyst for change. Thus, an effective environment should encourage the exploration of the dialogical process between pedagogy and technology (pp. 9-10).

Based on these principles, the focus of learning-by-design-approach is on learning by doing rather than traditional lecturing or teaching. It requires teachers to take control of their own learning and become practitioners and construct artefacts such as digital videos or websites. In this approach, teachers focus on a problem of practice and seek ways to use technology to address the problem. Thus, in this process they learn about technology. As teachers become active users of technology by being designers, they learn to use the available technologies creatively, and in novel and situation specific ways to achieve their teaching goals (Mishra, Koehler & Zhao, 2007). Because of its nature, design cannot be taught in a

traditional way. It can be understood "in dialogue and action" and "involves reflection in action" (Mishra & Koehler, 2006, p. 1035).

Koehler and Mishra (2008) quote Schwab (1983) to emphasize their view of teachers as "*curriculum designers*" (p. 21).

> Teachers will not and cannot be merely told what to do... Teachers are not assembly line operators, and will not so behave... There are thousands of ingenious ways of in which commands on what and how to teach can, will, and must be modified or circumvented in the actual moments of teaching. Teachers practice an art. Moments of choice of what to do, how to do it, with whom and at what pace, arise hundreds of times a school day, and arise differently every day and with every group of students. No command or instruction can be so formulated as to control that kind of artistic judgment and behaviour, with its demand for frequent, instant choices of ways to meet an ever-varying situation.

The idea of teachers as curriculum designers emphasize their active role in the implementation process of the curriculum as decision makers. The way they construct the curricula is affected by their personality, history, ideas, beliefs and knowledge (Koehler & Mishra, 2008) and "they constantly negotiate a balance between technology, pedagogy, and content in ways that are appropriate to the specific parameters of an ever-changing educational contexts" (p. 21).

Koehler and Mishra suggest that learning to work with wicked problems requires practice. Thus, pre-service or in-service teachers should be provided with multiple opportunities to work through these problems before they actually start teaching via working through problems or cases or practicum.

Learning by design approach, as Koehler and Mishra (2005) state, is aligned to the project-based approaches such as learning-by-doing, problem-based-learning, collaborative learning frameworks and design based learning philosophically and pragmatically. All these approaches require teachers to work collaboratively over extended periods of time to solve authentic problems (Koehler, Mishra, & Yahya, 2007). The learning technology by design approach "extends these ideas to a consideration of authentic design problems for developing skilful teachers' reasoning about educational technology" (p. 744). In this approach, teachers are offered little direct instruction about technology but expected to learn about it on their own or with the help of their peers (Mishra, Dirkin, & Cavanaugh, 2007). Such an approach helps teachers learn "how to learn" about technology and "how to think about" educational technology as they explore technology while trying to solve educational problems. While standard workshop approach assumes teachers as "passive consumers of technology", the learning by design approach sees teachers as "designers of technology." The learning by design approach creates opportunities for teachers to experience the connections between content, pedagogy and technology. Due to the ill-structured nature of authentic pedagogical problems, teachers become aware that there is not a single, unique solution to them. Thus, "teachers are more likely to encounter the complex and multiple ways in which technology, content, and pedagogy influence one another instead of thinking about rigid rules that imply simple cause-effect relationships between these components (Mishra, Spiro, & Feltovich, 1996, cited in Koehler, Mishra, & Yahya, 2007).

2.3.3. Research on the development of TPACK

A number of research studies were carried out to investigate the development of TPACK among the pre- and in-service teachers of various subject matters such as science, mathematics or social studies.

In his study with 22 graduate students enrolled in a one-year program to prepare science and mathematics teachers to integrate technology, Niess (2005) focused on the development of TPACK. The emphasis of the program was on using technological tools in a content lesson rather than on introducing technological tools in isolation. The program spanning four quarters was designed to address four themes: (1) research-based teaching and learning; (2) technology integration (TPACK); (3) PCK development; and (4) instructional practice integrated with campus-based coursework. The program included a specific technology component in each of the four academic terms and the technology components were taught by subject-specific technology educators. One classroom component of the program asked participants to micro-teach a technologically enhanced lesson. Throughout the program, the participants were also required to do their practicum during which they were expected to incorporate technology into their lessons and required to reflect upon their experiences. Reflections focused on their understanding of the content, success of the technology integration, and the teaching of the lesson with technology.

Qualitative data came from five cases and were coded using the four components of TPACK adapted from Grossman's (1988, 1989) PCK definition. Findings of the data revealed various levels of success for all the participants in the development of TPACK. It was observed that 14 of the 22 participants developed TPACK for using technologies to engage students in learning science and mathematics. Eight participants stated themselves that they needed more work toward developing their TPACK. Five cases were discussed to see the differences in the development of TPACK.

For example, Denise had a positive attitude toward working with technology and considering various technologies. However, she mentioned that the use of the technology was outside her job description and she continued to question the integration of technology

because “she did ‘not know how to change and modify’ an instructional approach that, for her, was not ‘yet fully developed’ for teaching science” (p. 514). Marissa, however, with the help of her classroom supervising teacher, planned a unit involving a particular technology so that her students could get a “clearer understanding” of the subject matter. She defined technology as “important in meeting the objectives in a science course” (p. 515). This perspective of her was reflected in her teaching experience during the practicum. Terry also integrated technology in his teaching and he stated that, as a result of his teaching, “an integration of technology in the strategies motivated students as well as enhanced their learning” (p. 517). Karen believed that “all of the content objectives for chemistry could be met without computer-based technology” (p. 517). According to her, technology was not needed to learn the basic concepts of science and her beliefs were reflected in her teaching. Finally, Dianne had strong beliefs about the importance of the use of technology in teaching mathematics. She stated, “I will not refuse a new technology because it appears too difficult to learn. I will only refuse a new technology if it does not relate to mathematics.” She felt that “technology was integral to mathematics and thus to learning mathematics” and, by the end of student-teaching, she was able to engage her students as active learners of mathematics (Niess, 2005, pp. 515-519).

In his dissertational study, Suharwoto (2006) focused on the development of mathematics pre-service teachers’ TPACK in a subject specific, technology integrated one-year long teacher preparation program. The study also aimed to explore what features or components of such a program were influential to their TPACK development. The six aspects of the program examined were coursework, microteaching, e-portfolios, faculty or course instructor, university supervisor, and cooperating teacher. Data came from course attendances, classroom observations, interviews, questionnaires, classroom artefacts, researcher journal, and PTs’ work samples. Three cases of PTs were purposefully selected for the study. Each

case consisted of three episodes: prior to the program, during the course work, and during student teaching. Each episode provided the PTs' description about their TPCK in the context of the program. The findings of the study revealed that all the participating PTs showed various degrees of understanding the four components of TPACK: an overarching conception what it means to teach mathematics with technology; knowledge of instructional strategies and representation; knowledge of students' understanding, thinking, and learning; knowledge of curriculum and curriculum materials that integrate technology in mathematics. The study also showed that different understanding of those PTs' TPACK was reflected in their practices during student teaching. The practices of PTs' TPACK were categorized into four different levels as "accepting, adapting, exploring and advancing". Finally, the study found that the PTs indicated that all the coursework in the program was primarily responsible for the development of their particular levels of TPACK. E-portfolios, micro-teaching and university supervisors were found to have a strong influence on pedagogy, while the cooperating teacher influenced pedagogy and content.

Harrington (2008) carried out a case study to which five PTs participated. The participating PTs were enrolled in a teacher education program which implemented various approaches to the development of TPACK. The purpose of this study was to document the development of PTs' Technology Specific Pedagogy as they learned to teach mathematics with technology during their initial licensure program. The study also aimed to investigate how the Technology Partnership Project and its features facilitated PTs' development of TPACK. The participants' ideas were explored to understand their reasoning about teaching with technology, their overarching conception of teaching mathematics with technology and their knowledge of students' understanding, thinking, and learning in mathematics with technology. Five PTs were followed during coursework and participation in the Technology Partnership Project field experience. For data, course participation, course assignments, team

planning meetings, teaching observations, teaching artefacts, and interview transcripts were documented and analyzed as evidence of the development of PTs' Technology Specific Pedagogy. Three PTs were purposefully selected for in-depth case analysis. Those PTs' comments revealed that they liked experimenting with technology to enhance the effectiveness of a lesson, their knowledge of students' understandings, thinking and learning improved as they actually taught in a real classroom and finally they learned from their peers throughout the study.

In another dissertational study by Cavirn (2007), TPACK development of PTs was explored. The participants of the study were six PTs enrolled in a semester long technology course required as part of a teacher education program. Five of the students were from mathematics education major and one was from science education major. The microteaching lesson study (MLS) process was conducted with two groups, with 3 PTs in each group, working to develop a content-area lesson incorporating the use of a technological tool.

The study was conducted as follows: First, a technological tool was introduced and discussed in class, and the instructor (researcher) selected a content-related lesson incorporating that tool, and modelled technology-enhanced instruction, with the PTs participating as students. After each modelled lesson, PTs prepared written feedback on the effectiveness of the choice of technological tool, the pedagogical strategy used to employ the technological tool, and the perceived impact on student learning achieved by employment of the technology tool. These feedback forms were discussed during technology class, modelling the reflective cycle of the MLS process. Midway through the term, the microteaching lesson study process was initiated. The six participants were purposefully assigned to two groups of three, based on background data collected as well as free time availability for group meetings.

Each group was assigned the task of teaching a lesson that would engage the students in exploring mathematical patterns and/or relationships using technological tools in order to

develop a rich understanding of a mathematical topic. During the three hours of technology class meeting time, the groups explored resources for appropriate technology enhanced lessons, made a selection, and developed lesson plans.

Data were collected during the entire semester using a variety of methods. Audio recordings were made of all group meetings, and video recordings were made of all lesson presentations. Fieldnotes were kept by the researcher, and paper copies of teacher feedback forms completed following each teaching of the lesson were saved. Each MLS group maintained an electronic folder containing copies of the group's lesson plans with between-teaching modifications, original and modified copies of all handouts and electronic files used in teaching the lesson, and individual participant feedback forms completed following the first and second presentations. At the end of the MLS process, individual participants also submitted directly to the researcher a final reflective summary survey of the MLS process. Individual interviews were also conducted at the conclusion of the MLS process to allow for exploration of the preservice teacher's comments on the final survey as well as to clarify any prior feedback submitted during the process.

The findings of the study revealed that, first, there occurred several changes in TPACK as the participants worked through the MLS process. Participant's TPACK in the early stages of the research study focused more on procedural mathematical knowledge and the use of the technological tool primarily in performing arithmetic calculations. Later in the process, the emphasis was placed on conceptual knowledge and the relationship between the computations and the overall objective of the lesson. The development of TPACK was also evident in the specific pedagogical strategies related to the use of the technological tool, primarily in the areas of pacing and sequencing of the lessons. As the participants recognized weaknesses in these areas, modifications were made to enhance the effectiveness of the lesson. Another change observed was in relation to the use of a technological tool in a student

centred environment. Modifications to the lessons carried out by the participating teachers reflected that they assumed more student-centred approach.

It is discussed by Cavinr that the study was successful for three reasons: First, PTs in the study were “learning technology by design.” They worked together in groups and tried to develop, modify and enhance their group lessons. They designed real lesson plans and in their design focused on the interaction of technology, pedagogy and content, as emphasized in the TPACK framework. Second, PTs taught their lesson plans in a situated environment so that they could experience the challenges of dealing with technological diversity among classroom students, and adapt the lesson to fit the students' needs. Finally, the repetitive cycle of the MLS process allowed the PTs to reflect upon the effectiveness of the lesson, make modifications, and implement these modifications in subsequent teachings of the lesson. The combination of these experiences provided opportunities for, and encouraged development of, technological pedagogical content knowledge in the PTs.

In their study, Koehler, Mishra, and Yahya (2007) aimed to investigate whether learning by design approach leads to the development of more complex forms of knowledge and whether TPCK develops over time and through collaborative activity. The research was conducted in a faculty development course in which faculty members and graduate students worked collaboratively to develop online courses to be taught the following year. The participants were six faculty members and 18 students. They met once a week for three hours in a computer lab. Students were assigned to groups led by individual faculty members. A typical class period included two components: a whole-group and small-group. During the whole-group component, the faculty members and students were engaged in discussions on readings and issues relevant to all groups. The small-group component required design teams to work on their semester-long projects. During the design process, they were exposed to several technologies. They also needed to assess their usefulness so that they could choose

one to include in their design of their online class. The technologies used by the groups varied, depending on the content they were covering and the pedagogical decisions they made.

Data for their study came from observations of the two of the faculty members and their students. The data collected from these two groups included detailed notes taken from group discussions both in and out of class, e-mails between members of the groups, notes and other artefacts constructed by the groups, self-progress surveys periodically taken throughout the semester and the detailed field notes of the researcher.

For the analysis of the data, quantitative content analysis was conducted. First, the representative samples of the communication to be studied were identified. Then, a protocol was created to identify and categorize the target variables, followed by the training given to the coders. The coding protocol was based on the TPACK framework. Finally, after coding the transcriptions, the data were analyzed either to describe the target variables or to identify relationships between them.

Data coming from 15 weeks were divided into three segments as the beginning (weeks 1-5), middle (weeks 5-10) and end of the semester (weeks 10-15). Then, one week, including the most amount of data, from each segment was chosen. The coding procedure was applied to this selected data of the two design groups: Adams Family group and Jackrabbits group. The aim of coding was to understand the focus of conversations between the members of the teams. Each discourse episode was categorized as Technology (T), Content (C), Pedagogy (P), Pedagogy and Technology (PT), Content and Technology (CT), Content and Pedagogy (CP), or Content and Pedagogy and Technology (TCP). Three additional categories used for coding the segments were group dynamics, social and miscellaneous as some of the interaction occurring were not related to technology, content or pedagogy. After coding the data, the researchers conducted a quantitative analysis of the occurrence of particular

categories (T, P, C, TP, TC, TPC and TPCK) to understand the nature of interaction among the design group members. Their expectation was that the initial interactions of the participants would treat content, pedagogy, and technology as isolated concepts. Later, their interactions would recognize the relation between these components and show examples of more CP, CT, PT, and TCP categories as the design project progressed.

The findings of the quantitative analyses showed that both design teams moved from "considering technology, pedagogy and content as being independent constructs towards a more transactional and co-dependent construction that indicated a sensitivity to the nuances of technology integration." In other words, they began to develop an understanding of the interrelationship of the three components. The qualitative analysis showed how the groups developed or did not develop in their thinking of teaching content with technology. It was seen that both groups showed some changes in terms of the roles played by the participants and the nature of meaning making within the groups. Based on their findings, Koehler, Mishra, and Yahya (2007) suggest that "developing TPCK is a multigenerational process, involving the development of deeper understandings of the complex web of relationships between content, pedagogy and technology and the contexts within which they function."

2.3.4. Applying the TPACK Framework to language teacher education.

Changes having occurred in the field of education in terms of the role of technology over the last three decades have affected the conceptualization and practice of learning and teaching of second and foreign languages as well as the body of knowledge that teachers need to promote successful language learning of their students (Van Olphen, 2008).

Hughes (2000) generated the concept of E(nglish)-TPCK which was specific to the English discipline (see Figure 7). According to this concept, teachers' existing knowledge and developing knowledge explain the differences in their learning and use of classroom

technologies. The concept built on Shulman's PCK conceptualization and applied its generic categories to the teaching of English. E-TPCK and its related TPK, TK and TCK described the knowledge that English teachers develop and use to create learning opportunities, in which technology is integrated, to help students learn English (Hughes & Scharber, 2008).

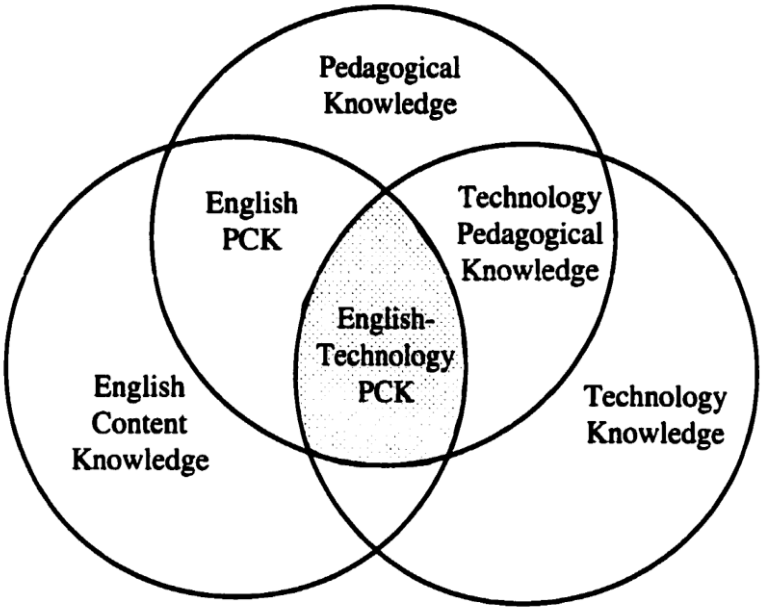

Figure 7. English-technology pedagogical content knowledge (adopted from Hughes, 2000).

There are not many studies focusing on the kinds of knowledge language teachers need to have for integration of technology in thoughtful and pedagogically sound ways into the curriculum (Van Olphen, 2008). The following section illustrates the kinds of knowledge that foreign language teachers need to have for effective integration of technology:

2.3.4.1. Content knowledge of foreign language teachers.

Conceptualizations as to what specifically constitutes subject matter in language teaching vary. Content knowledge refers to teachers' understanding of the specific discipline and inclusive topics that he or she has been assigned to teach (Gess-Newsome, 1995). The

content knowledge regarding language instruction includes morphology, language usage, language skills, communicative skills and relevant cultural knowledge (Lu, 1997). Lafayette (1993) suggests three components encompassing language teachers' subject matter knowledge: (1) language proficiency, (2) civilization and culture, and (3) language analysis (knowledge about the language). These components suggest that CK for language teachers should involve the study of language-specific linguistics, i.e., morphology, phonetics, phonology, pragmatics, second language acquisition, semantics, socio-linguistics, and syntax; and the development of cross cultural awareness as well as near-native language proficiency (van Olphen, 2008).

Richards (1998) proposes six dimensions to examine the core knowledge base of second language teachers: (1) subject matter knowledge, (2) communication skills and language proficiency, (3) teaching skills, (4) theories of teaching, (5) pedagogical reasoning skills and decision making and, (6) contextual knowledge. According to van Olphen (2008), the first two dimensions of Richards, namely, subject matter knowledge and communication skills and language proficiency are closely related to the content knowledge. Richards proposes that subject matter knowledge includes "teachers' understanding of the nature of language and language use; the nature of second language learning; and approaches to language teaching, curriculum development, testing and evaluation and materials development" (p. 15).

Content knowledge of English teachers includes, as Hughes (2000) and Hughes and Scharber (2008) suggest, not only deep understanding of the subject but also a conceptual understanding of the structure and modes of inquiry for the discipline. Teachers know facts and concepts related to the discipline, frameworks to be able to explain those facts and concepts and "the path(s) new content takes to become part of the discipline" (Hughes &

Scharber, 2008, p. 88). According to them, the content knowledge of English teachers in the middle and high school consists of topics and concepts such as theatre, film and media studies, remedial reading, American/British/world literature, contemporary literature, creative writing, journalism, critical approaches to analyzing literature, grammar, speech and debate, language acquisition and development, mythology, and Shakespeare. Teachers know the way to sequence the curriculum, choose appropriate texts and know how to represent these to the learners.

2.3.4.2. Pedagogical content knowledge of foreign language teachers.

Language teachers' pedagogical content knowledge has also been a matter of concern (Arva & Medgyes, 2000; Reves & Medgyes, 1994). Pedagogical content knowledge, in general, refers to what teachers know about teaching their particular subject matter. PCK for language teachers refers to "what teachers know about teaching the target language to empower students to communicate across linguistic and cultural borders" (van Olphen, 2008, p. 112). Richards' four remaining domains are relevant to the concept of PCK suggested by Shulman (van Olphen, 2008). These domains are theories of teaching, teaching skills, pedagogical reasoning and contextual knowledge. These domains "provide second language teachers education with an agenda that promotes and strengthens the teachers' engagement in the exploration of knowledge, beliefs, attitudes, and thinking as they inform their teaching endeavors" (van Olphen, 2008, p. 113).

Suggestions as to what constitutes language teachers' pedagogical content knowledge, according to Wing (1993) also includes competencies such as how learners learn languages, language development stages, learning styles, preparing and implementing communicative-oriented activities, knowledge of learners and their errors.

2.3.4.3. Technological content knowledge of foreign language teachers.

TCK refers to the knowledge of teachers about how technology and subject matter knowledge are interrelated (Koehler &Mishra, 2006). TCK specific to language teachers is defined as "the body of knowledge that teachers have about their target language and its culture and how technology is used to represent this knowledge" (van Olphen, 2008, p. 113).

As mentioned in van Olphen (2008), a number of studies have been conducted to investigate the effect of new technologies on foreign language learning and this area of research is called as Computer Assisted Language Learning (CALL hereafter). CALL aims to explore how technology assists language teachers in representing content knowledge. Those studies have focused on the improvement of language skills as well as the cultural knowledge through use of various technologies such as the Internet, chatrooms, podcasting, blogging, etc. The contributions of CALL to the field of foreign language education are crucial to the understanding of teachers' technological content knowledge. Teachers should know how the use of different technologies shapes their teaching practices. If they are not aware of these findings and hesitate to incorporate this technology into their teaching practice, they won't be able to integrate technology in a pedagogically sound way (van Olphen, 2008).

2.3.4.4. Technological Pedagogical Content Knowledge of foreign language teachers.

van Olphen (2008) referred to TPACK as a framework for thoughtful and pedagogically appropriate integration of technology into the curriculum and suggested that the foundation of effective integration of technology in language teaching requires the following: an understanding of the ways linguistic and cultural concepts can be represented using technology; educational approaches to language teaching drawing from socio-constructivist philosophies for the development of students' language and cultural competence; an

awareness of the factors facilitating or hindering the language acquisition process and the development of language competence and how technology helps students with common problems they ordinarily face; an awareness of students' previous knowledge, especially, a knowledge of second language acquisition and cognitive development theories; and finally "an understanding of how current and emerging technologies can be used to advance present knowledge and to develop new epistemologies and sustain previous ones" (p. 117).

According to van Olphen, TPACK offers a conceptual foundation for language teacher education programs which envision pedagogically meaningful integration of technology. He stresses the need for teacher education programs to prepare language teachers "to opt for, adapt, implement, and even design meaningful technology based activities that are aligned with current approaches to language learning and teaching" (p. 117).

2.4. Summary

To summarize, the literature on teacher knowledge has revealed that what teachers know and how they express their knowledge determines their classroom performance. There exits a significant body of research on teacher knowledge, particularly on PCK, in the fields of science and mathematics. However, in the field of English language teaching (ELT), these studies are very limited in number. Based on the research findings conducted in the field of second/foreign language teaching, it can be concluded teachers' language learning experiences, their teaching experience, and their professional coursework have been found to influence the development of their knowledge base.

Since the expanding use of technology has led to the changes in the nature of education, 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). A number of theories ad frameworks have been proposed in order to guide research in the area of teacher knowledge

about technology integration and to inform teacher preparation in technology integration (e.g., Angeli and Valanides, 2005; 2008; Margerum-Rays & Marx, 2003; Mishra & Koehler, 2006; Keating & Evans, 2001; Niess, 2005; Pierson, 2001).

One of these frameworks, the TPACK framework by Mishra and Koehler (2006), describes "how teachers' understanding of technologies and pedagogical content interact with one another to produce effective teaching with technology" (Koehler & Mishra, 2008, p. 12).

How teachers will acquire TPACK has been a focus of research recently and number of research studies were carried out to investigate the development of TPACK among the pre- and in-service teachers of various subject matters such as science, mathematics or social studies (Cavirn, 2007; Harrington, 2008; Koehler, Mishra, & Yahya, 2007; Niess, 2005; Suharwoto, 2006). Those studies have revealed that pre-service teachers' TPACK developed when they were designed their own lessons integrating technology and when they had the opportunity of implementing their plans.

To the best knowledge of the researcher, there are no studies conducted to investigate the TPACK development of pre-service teachers of English. The present study aims to investigate how a coursework explicitly focusing on the framework of TPACK and designed following Learning Technology by Design approach helps develop the TPACK of Turkish pre-service teachers of English who were given the opportunity to apply what they learned in their coursework to their field-experience. In the following section, detailed information about the methodology of the study will be provided.

CHAPTER III

METHODOLOGY

3.1. Overview

This chapter discusses the methods of inquiry, population and the setting of the study, the treatment, data collection and data analysis procedures employed in detail.

3.2. The Methods of Inquiry

The present study employed a mixed methods approach in which elements of qualitative and quantitative research approaches are combined "for the purposes of breadth and depth of understanding and corroboration" (Johnson, et al., 2007, p. 123). Mixed methods approach was preferred for the present study because "the combination of quantitative and qualitative approaches provides a better understanding of research problems than either approach alone" (Creswell & Clark, 2007, p. 8). The following quotation from Strauss and Corbin (1998, as cited in Dornyei, 2007) further illustrates the strengths of this approach:

> Qualitative and quantitative forms of research both have roles to play in theorising. The issue is not whether to use one form or another but rather how these might work together to foster the development of theory. Although most researchers tend to use qualitative and quantitative methods in supplementary or complementary forms, what we are advocating is a true interplay between the two. The qualitative should direct the quantitative and the quantitative feedback into the qualitative in a circular, but at the same time evolving, process with each method contributing to the theory in ways that only each can (p. 34).

The strengths of mixed methods research are also listed by Dörnyei (2007) as follows: First, researchers using both quantitative and qualitative approaches can bring out the

strengths of both paradigms. The strength of one method can overcome the weaknesses of the other. Second, converging numeric information from quantitative data and specific details from qualitative data helps to gain a better understanding of a complex phenomenon studied. Finally, mixed methods research improves the validity of research and increases the generalizability of the results.

The present study began with a quantitative phase. In social sciences, quantitative research is described as an "inquiry that is grounded in the assumption that features of the social environment constitute an objective reality that is relatively constant across time and settings; the dominant methodology for studying these features is to collect numerical data on the observable behaviour of samples and subject them to statistical analysis" (Gall, Gall & Borg, 2005, p. 555). Quantitative research is used to study populations, or samples that represent populations, and study behaviour in a natural setting (Gall, Gall, & Borg, 2005). The quantitative data for the present study came from the Survey of Pre-service Teachers' Knowledge of Teaching and Technology (Schmidt, et al., 2009) applied at the beginning and end of the study in order to understand the extent to which pre-service teachers of English developed their TPACK. Following the administration of the quantitative survey, the qualitative phase of the study began.

Qualitative data is "a type of educational research in which the researcher relies on the views of participants, asks broad, general questions, collects data consisting largely of words (or text) from participants, describes and analyzes these words for themes, and conducts the inquiry in a subjective, biased manner" (Creswell, 2005, p. 41). In the field of qualitative research methodology, case study is discussed as a significant qualitative strategy or tradition along with phenomenology, ethnography, biography, and grounded theory (Creswell, 2003; Denzin & Lincoln, 2008; Guba & Lincoln, 1994; Hatch, 2002; Patton; 1990). Merriam (1998) states that "a case study design is employed to gain an in-depth understanding of the situation

and meaning for those involved. The interest is in process rather than outcomes, in context rather than a specific variable, in discovery rather than confirmation. Insights gleaned from case studies can directly influence policy, practice and future research" (1998, p. 19).

Case studies are different from other types of qualitative research as they provide intensive descriptions and analyses of a *single unit* or *bounded system* (Smith, 1978, cited in Merriam, 1998) such as an individual, program, event, group, intervention, or community. The aim of the case study research is to describe the unique cases and interpret emergent themes that differentiate or unite settings and/or participants (Yin, 2003). In case studies, the researcher uses multiple data sources (e.g., interviews, observations and document analysis) to construct a holistic and meaningful representation of personal experiences (Denzin & Lincoln, 2005).

Yin (2003) identified three types of case studies: exploratory, explanatory, and descriptive. For the qualitative phase of the present study, an exploratory multiple-case study design was used in order to understand Turkish EFL pre-service teachers' development of their TPACK, how their thinking about technology changes over time and whether and how their TPACK is reflected in their practice. In other words, the aim was to explore "the *manner* and *process"* by which TPACK develops and is reflected through participation in a design-based study as outlined by Koehler, et al., 2007 (p. 745).

Yin (1994) claims that exploratory case studies are conducted to explore the situations in which "the intervention being evaluated has no clear set of outcomes." The development of pre-service teachers' TPACK study is still an exploratory study since few studies have described the development of TPACK. Those research studies have addressed TPACK, each with different foci and the subjects in their studies (Pierson, 1999; Keating &Evans, 2001; Woodbridge, 2004; Niess, 2005) such as science, social studies and mathematics. In the

context of language teacher education, there are no studies conducted describing the development of TPACK.

The TPACK construct is used in this study to organize and inform the analysis of the data. The TPACK framework theorizes component knowledge integrating into a unique amalgam of knowledge, thereby describing a developmental process. Koehler and Mishra (2005) have argued that due to the highly complex, situated, and transactional nature of TPACK, the best way to develop it is through direct experience in situations that require its application.

This exploratory study developed six pre-service teacher cases, purposefully chosen for the expectation of gaining in-depth and sufficient information about pre-service teachers' development of TPCK and their practice in teaching English with technology. Purposeful sampling was used to select participants for the qualitative phase of the study as "the logic and power of purposeful sampling lies in selecting *information rich cases* for study in depth. Information rich cases are those from which one can learn a great deal about issues of central importance to the purpose of the research" (Patton, 1990, p. 169).

As recommended by Yin (2003), data were collected through multiple sources in order to obtain information toward answering the research questions. The primary data source for describing the pre-service teachers' TPACK was obtained from written reflections, interviews, lesson plans, and classroom observations. Additional data sources such as handouts and textbook materials were also collected from the classroom documents used during student teaching. The researcher also kept fieldnotes during the study. Data from each source in the present study were complementary and helped to obtain a holistic picture of PTs' development of TPACK.

Table 1

Relationship of the research questions to data collection and analysis

Research Questions	Sources of data	Data collection	Analysis strategies
1	All PTs (N= 22)	The TPACK Survey	A Dependent means *t*-test (SPSS)
1	Selected cases (N= 6)	Written reflections Interviews	Content analysis
2	Selected cases (N= 6)	Lesson plans Classroom observations	Observation rubric

3.3. Context of the Study

3.3.1. The setting.

The present study was conducted in the second semester of the 2009-2010 academic year. The setting was an English language teacher education program at a state university in Turkey. The university is both an English and Turkish medium university with approximately 51.000 students. The foreign language teacher education program is offered by a Faculty of Education which accommodates ten departments with 22 programs. The Department of Foreign Language Education offers B.A. and M.A. programs in English, French, and German Language Education.

The four-year English Language Teacher Education program has approximately 800 undergraduate students. The components of the undergraduate program consist of professional courses including methodological and pedagogical approaches to foreign language teaching as well as courses raising students' awareness of the English language system. The program also

offers courses on first and second language acquisition and organizes practice teaching in selected schools.

According to the curriculum of the English Language Teacher Education program, as designed by the Turkish Council of Higher Education, in their first year, PTs receive courses such as Contextual Grammar, Advanced Reading and Writing Skills, Oral Communication Skills, Effective Communication, and Phonetics and Phonology, most of which focus on the development of English language skills. In the second year, the courses offered are English Literature, Linguistics, Approaches and Methods in Second Language Teaching, Teachers' Presentation Skills, Translation, Special Teaching Techniques, Research Skills, Language Acquisition and Technology and Materials Design. The third year courses in the program include Teaching English to Young Learners, Teaching Language Skills, Special Teaching Techniques, Teaching English through Literature, and Translation. The final year courses include Materials Evaluation, Testing and Evaluation, Course book Evaluation, Language and Culture and School Experience.

In addition to the courses offered by the English Language Teacher Education program, PTs are also offered other courses such as Educational Psychology, Classroom Management, Guidance and Counselling and Computer by various departments of the Faculty of Education.

Related to technology, PTs receive two courses: Computer and Technology and Materials Design. The Computer course, which is a standalone technology course received in the first and second semesters of the freshman year, focuses on the development of basic computer skills such as learning how to use office programs and selected softwares and how to use the Internet effectively. Technology and Materials Design course, offered in the second semester of the junior year, in general, aims to teach PTs how to teach English using technology.

3.3.2. The participants.

At the time of the study, in the senior year of the English Language Teacher Education program, 217 pre-service teachers were enrolled. In the final week of the first semester of the 2009-2010 academic year, all PTs were informed of the research project and that participation was strictly voluntary. They were told that all data collected would be done so confidentially, and that the results would be shared with the participants at the conclusion of the study. For these purposes, an invitation form (see Appendix A) clearly stating the aim of the study was delivered to PTs. On the form, PTs were also informed about the issues to be focused on during the study and skills they would gain after participating in the study. The PTs were asked to choose the options of "yes" and "no" indicating their preference to participate in the study voluntarily. The students who chose "yes" were asked to write their names, e-mail addresses, and phone numbers. They were also asked to indicate the name of their practicum schools. In relation to their practicum schools, they were given statements focusing on the possible technological facilities at schools and expected to state whether their practicum schools had these facilities. Among 217 PTs, 54 PTs (42 female, 12 male) volunteered and they all noted that their practicum schools had one or more of the technological facilitities listed on the form. There were 20 schools where these 54 PTs did their practicum. Four out of 20 schools were a private primary school, six were a state primary school and 10 were a state high school. Twenty out of 54 PTs did their practicum at a state primary school, 25 PTs at a state high school and nine PTs at a private primary school. All schools had a projector and/or overhead projector and a portable CD player. Three schools had Internet connection and computer laboratory. In nine schools, there was a computer in the classroom.

Due the limited capacity of the computer laboratory, 22 PTs (17 female, 5 male) were chosen by random sampling to represent the sample. Each PT, then, was individually contacted by the researcher and explained the purpose of the study and the required time

commitment. All 22 PTs agreed to participate in the study and signed the Informed Consent Form (see Appendix B).

What was common to all participating PTs was their lack of training on the educational uses of technology. Although such a course is offered in the sophomore year of the program, this particular group of PTs did not receive it due to the lack of trained teaching staff in the department. Instead, under its title, they studied Classroom Management.

For the qualitative phase of the study, six PT among these volunteering 22 PTs were purposefully selected as the cases of this research. As Patton (1990) states "the logic and power of purposeful sampling lies in selecting information rich cases for study in depth. Information rich cases are those from which one can learn a great deal about issues of central importance to the purpose of the research" (p. 169).

Using pseudonyms, six participants were identified as Özlem, Hande, Gozde, Nil, Pinar and Zeynep. All PTs, as the requirement of "School Experience I/II" courses in the senior year of the program, were placed to the schools organized by the department to do their practicum. School Experience I course, offered in the first semester of senior year, requires student teachers to do structured observation tasks followed by discussions related to theoretical and experiential considerations in EFL. The School Experience II course, in the second semester, is based on observation and supervision of carefully prepared student teaching in selected schools followed by critical appraisal. PTs are supposed to carry out five micro teachings and two macro teachings. For both courses, PTs spend 6 hours in the school site. In the following section, brief information will be provided in relation to the practicum schools of the six PTs.

Pinar: Pinar's placement school was a state Anatolian high school. She attended the lessons of 9th grade students. The classrooms at school were equipped with a computer and a

projector. *Solutions* (Falla & Davies, 2009) was studied as the coursebook and the classroom had a computer and projector.

Gözde: Gözde's practicum school was a state Anatolian high school and the class she participated in consisted of 32 students enrolled in the 9th grade. The coursebook studied was an elementary level coursebook called *Upstream A2* by Express Publishing (Evans & Dooley, 2006). The classroom at the school site had a computer, a projector, a CD player and an OHP.

Zeynep: Zeynep attended to a private primary school during her practicum. The class was a 4th grade class with 18 students enrolled. The coursebook studied was *Incredible English 4* (Redpath, Morgan & Phillpis, 2007).

Nil: Nil did her practicum at a state Anatolian high school. The class she attended was a 9th grade class with 26 students. The coursebook used was *Upstream A2* by Express Publishing (Evans & Dooley, 2006). The classrooms at the school site had a computer, a projector and the Internet connection.

Özlem: Özlem's practicum school was a state Anatolian high school. Twenty-eight students were enrolled in the 9th grade and they used *Upstream A2* by Express Publishing (Evans & Dooley, 2006) as the coursebook. The classroom at the school site had a computer and a projector.

Hande: Hande's placement school was a private primary school. The class that she was observing throughout the practicum was a third grade class who had been learning English since kindergarten. They were using the coursebook called *Backpack 3* by Pearson-Longman (Herrera & Pinkley, 2010) which is the third level of seven-level communicative course for primary learners. The classroom she attended consisted of 24 students and was equipped with a computer, a projector and Internet connection.

3.3.3. The researcher.

The researcher of the present study is an instructor at the university where the study was conducted. She was introduced to educational technology in one of the courses she received in her PhD program. Being a technology-friendly person, in general, she was very enthusiastic in the idea of integrating technologies especially recent ones in language teaching. The course she received focused on using certain technologies to teach listening, speaking, reading and writing skills in English. For each skill, a certain technology was introduced and how that technology supports that particular language skill was discussed.

As an instructor in the English Language Teaching department, she has been supervising PTs in their student teaching for several years. One of the basic problems she recognized in relation to micro and macro teachings of PTs was the ineffective use of technology. In many instances, she saw that PTs were using technology for the sake of using it and when she asked them why they were using it, most of the PTs could not give an answer. Besides, she observed that the technology used did not bring any change to the teaching and learning process, i.e., PTs were using traditional language teaching methods, classrooms were teacher-fronted and students were passive recipients of the input.

While concerned with this problem, the researcher was introduced to the construct of TPACK by one of her advisors for this dissertation. After reading about the construct, the researcher believed that developing such knowledge in pre-service teachers and teachers would offer a solution to the problem she had been observing. She was aware that knowing about technology was not enough for teaching English with technology and teachers had to acquire a specific type of knowledge for that. The TPACK framework provided her with the answers she was looking for, so she decided to focus on its development in PTs in her dissertational study.

This choice was a challenge for her owing two reasons. First, the literature on TPACK did not present many examples from the English Language Teaching area and there were no experimental studies focusing on the development of TPACK in language teachers or teacher candidates. Second, even the course the researcher received in her PhD was "technocentric" in a sense and did not provide her with an example course developing TPACK. Such a challenge made her believe that this particular study would be valuable in its attempt to conceptualize how TPACK of pre-service teachers of English can be developed.

3.3.4. The treatment.

For the purposes of the present study, a special course was designed as a treatment to develop PTs' TPACK. Harrington (2008) observes that "in order to characterize the development of pre-service teachers' knowledge base, the development must be examined in context of coursework, field experiences and peer interactions" (p. 9) He adds that the development would be observed by analysing the way PTs defend their ideas in their reflections and coursework, the way PTs justify their thinking to their peers or instructors, and through the decisions they give during their teaching.

The literature offers little insight into how teacher preparation programs can develop TPACK through explicit integration of field experiences and university course work. Relevant research has shown that teachers feel inadequately prepared in using technology for instructional purposes (e.g., Hew & Brush 2007; NCES, 2000). As discussed in the previous sections of the thesis, for the meaningful integration of technology, content, pedagogy and technology should be considered together. Teachers' technological knowledge is an integral part of teachers' pedagogical knowledge and teaching technology skills should be integrated with subject area and method teaching (Mishra & Koehler, 2006). Using technology in integrated or innovative ways require a fluency of technology use in which users understand

the affordances and constraints of a technology and can manipulate it to meet their needs within the context of the problem (Mishra & Koehler, 2008). The following section discusses the theoretical framework followed to design the course for the study.

3.3.4.1. Theoretical framework of the treatment.

In order to help PTs develop TPACK, Koehler and Mishra (2005a, 2005b) suggested that Learning by Design (LBD), a project-based, learner-centred instructional theory provides a promising theoretical grounding for courses intended to teach these skills. Koehler and Mishra suggested that LBD, when applied to pre-service teacher technology education, offers opportunities for teachers to use technology in authentic problem solving contexts and to explore "the rich connections between technology, the subject matter (content), and the means of teaching it (the pedagogy)" (2005a, p. 95). Mishra and Koehler (2006) stated that to develop TPACK, teachers must have the opportunity to tackle the complex and dynamic relationships of content, pedagogy, and technology. Thus, teachers should learn TPACK in contexts that honor the dynamic relationships of the three components. Pope, Hare, and Howard (2005) also suggested that "preservice teachers need opportunities to learn with the technology by being exposed to authentic, learner-centered activities that allow them to construct their own understanding of the learning outcomes" (p. 574). When learners engage in an activity, the context of the activity becomes part of the knowledge and the problem that learners attempt to solve becomes their problem (Johnasson et al. 1999; Putnam & Borko 2000).

Theoretically, LBD evolves from the theoretical traditions of social constructivism (Koehler & Mishra, 2005a) and constructionism (Han & Bhattacharya 2001), case-based reasoning (Kolodner, 1997), problem-based learning (Han & Bhattacharya 2001; Koehler & Mishra 2005a; Kolodner et al. 2003) and theories about design (Koehler & Mishra, 2005a).

In a number of studies, Mishra and Koehler studied how the use of design-based activities contribute to the development of TPACK, believing that engaging in design activities is particularly useful in building understanding of complex ideas. Participants in their design studies created digital artefacts such as videos, websites, and online courses. In the process of working through design problems, participants developed TPACK by actually using and designing educational technology to teach specific content. As they discussed, engaging in design work helped teachers move from a divided view of technology, pedagogy and content knowledge to a unified perspective of the ways in which the different types of knowledge overlap.

It is recognized that the development of TPACK is a developmental process (Mishra &Koehler, 2006) and that pre-service and in-service teachers will exhibit varying degrees of such knowledge. Teachers' stages of learning to teach with technology begin with the mechanical level (or entry), during which teachers follow instructions explicitly and use the technology as the manufacturer or programmer intended. Next teachers progress to the meaningful level during which they think of or accept alternate ways of using the technology. In the final stage of learning to teach with technology, teachers' practice reflects the generative level in which they move away from traditional uses of technology, take into account their content and are aware of appropriate and inappropriate uses of technology (Zhao, et al. 2006). The developmental nature of TPACK was one of the factors guiding the course design of the present study.

In relation to the development of TPACK, Niess (2008) discusses that "no matter how marvellous the coursework is in providing them with knowledge about teaching with technology, they must have opportunities to apply this knowledge" (p. 246). She suggests microteaching to give preservice teachers the opportunity of practising and states that "microteaching provides opportunities for them to test their developing ideas for establishing

classrooms conducive to learning with technology." Field experiences help preservice teachers to understand the importance of planning and preparation, the value of specific instructional strategies and comprehend the complexities involved in teaching with technology, thus developing their TPACK.

Based on the theoretical framework, it can be stated that in order to help pre-service teachers develop TPACK, the learning environment must address the situated nature and complex interplay of technology, pedagogy and content. Learning by Design (LBD) has been proposed as a promising instructional theory to create such a learning environment. In addition, the combination of coursework and fieldwork would support this necessary learning environment by providing PTs with the opportunity of understanding the complexity involved in teaching with technology.

For the development of the course for PTs of English in the present study, the TPACK framework was applied and the LBD theory was adapted to the context. Coursework and fieldwork were combined and certain types of experiences and learnings were planned to bring about the TPACK. The course design attempted to adhere to the following four principles: (1) design tasks were problem-centred (Merrill, 2002); (2) skills were developed via learning technology by design approach (Mishra & Koehler, 2006); (3) PTs worked collaboratively (socio-cultural theory); and (4) PTs engaged in reflective practice (Schon, 1983). The following section explains the course structure in detail.

3.3.4.2. The Course Structure.

The course designed as a treatment for the present study lasted 12 weeks. The participating PTs met with the instructor, the researcher, in a computer lab for three hours weekly. The first meeting began with the collection of pre-data. Following that, PTs were given the syllabus of the course outlining the content of the course weekly and they were

informed about their responsibilities. The instructor explained why the development of teacher knowledge in relation to technology was a relevant issue in the Turkish context and justified this need by giving specific examples she experienced herself. PTs were also introduced to the blog created by the instructor in order to be used during the study for sharing information.

In the second week, the lesson began with a discussion on the reasons why the use of technology is becoming increasingly important in English Language Teaching (ELT) practice. The instructor followed the lesson through the slides she prepared (see Appendix G). The second topic discussed was the meaning of 'technology.' PTs were asked about their definitions and understandings of technology and to give some examples of technological tools they knew. Referring to the fact that there are various types of technological tools available and that technology is changing rapidly, PTs were told that "rather than focusing on certain technologies, it becomes more important to think about ways of thinking in this world" (Mishra & Koehler, 2010). It was also emphasized that "it is not the technology alone, but rather how teachers integrate it with their teaching that matters (Mishra & Koehler, 2010). The discussion continued with the discussion on teachers' use of technology. PTs realized how teachers' technology use was limited to few technological tools, especially in the Turkish context. This discussion focused on the quotation of Mishra and Koehler (2010) saying "it is not the technology alone, but rather how teachers integrate it with their teaching that matters." The instructor continued the lesson by mentioning the categorization of technology, used by Mishra and Koehler (2008), as digital and analogue technologies and provided PTs with examples. PTs were told that analogue technologies such as textbooks or blackboards were transparent in pedagogical use as they had been so embedded in the classroom that they were comparatively transparent in pedagogical use (Mishra & Koehler, 2006). Thus, teachers and

students do not think much about them. The situation is different for digital technologies- their use has not become transparent yet (Mishra & Koehler, 2006).

PTs were introduced with the terms ‘affordances’ and ‘constraints’ and told that technologies had their own features that made them more suitable for certain tasks rather than others (Mishra & Koehler, 2008). They were given specific examples of different technologies focusing on their affordances and constraints and told that before using technologies for educational purposes, they needed to understand their affordances and constraints.

The discussion continued with the nature of teaching and it was emphasized that “Teaching is a highly complex activity that draws on many kinds of knowledge," including "knowledge of student thinking and learning, and knowledge of subject matter" (Mishra and Koehler, 2006, p. 1020). It was also added that the addition of digital technology to the classroom further complicates the situation, creating a "wicked problem" (Rittel & Webber, 1973, cited in Koehler & Mishra, 2008) for teachers (Mishra & Koehler, 2007). PTs were explained that attempting to solve a wicked problem may create another problem. Moreover, wicked problems are “unique” and “novel” and “solutions to wicked problems are not right or wrong, simply ‘better,’ ‘worse,’ ‘good enough,’ or ‘not good enough.’” (p. 11). There is no single solution to a technology integration problem. “Quality teaching requires developing a nuanced understanding of the complex relationship [among] technology, content, and pedagogy, and using this understanding to develop appropriate, context-specific strategies and representations” (Mishra & Koehler, 2006, p. 1029).

Following that, PTs were introduced to the term “repurposing” and told that “only repurposing makes a technology an educational technology” (Mishra & Koehler, 2010). In relation to repurposing, it was emphasized that “technology is not used just one way and users use technology in a way not anticipated initially” (Mishra & Koehler, 2010). “Users

determine what the zone of possibility allows for creative use of technology" (Koehler& Mishra, 2008). To make the meaning of "repurposing" clear in the minds of the PTs, they were asked to redefine a technology, take a picture of their idea and share it on the classroom blog in the following week. This task was given to PTs to make them understand how to repurpose technologies in general. To clarify the concept, PTs were shown two videos of language classrooms in which mobile phones and blogs were used for educational purposes. The TPACK framework was introduced to PTs by mentioning that "if teachers are to repurpose tools and integrate them into their teaching, they require a specific kind of knowledge- TPACK" (Mishra & Koehler, 2010).

The third week continued with the discussion of the TPACK framework. PTs were told that "the skills, competencies, and knowledge specified by the TPACK framework require teachers to go beyond their knowledge of particular disciplines (content), technologies (technology) and pedagogical techniques in isolation (pedagogy)" (Mishra & Koehler, 2010). TPACK knowledge was explained as "a flexible kind of knowledge that lies at the intersection of all three of these knowledge bases, allowing the creative repurposing of the traditional approaches" (Mishra & Koehler, 2010). PTs were told that the relationship between technology and education is reconsidered in the TPACK framework and it is recommended to teachers that a "technocentric" view of technology, termed by Papert, should be left behind (Harris, Mishra, & Koehler, 2007). A "technocentric" view begins with a focus on technology before moving to content and pedagogy. In other words, such a view focuses on "**what**" teachers need to know about technological tools and resources. A more important focus is understanding "**how** [and **why**] the technology is used" (Mishra & Koehler, 2006, p. 1018, emphasis added).

In relation to TPACK, it was emphasized that teachers' job involved teaching (pedagogy) students specific subject matter (content) (Mishra & Koehler, 2010). In relation to

content, it was discussed that the goals of education were to convey disciplinary knowledge and disciplines which offered teachers different ways of thinking and looking at the world. A classroom discussion was held on the content knowledge of language teachers. PTs were told that teaching science with technology might be very different from teaching English with technology, even if you used the same technology, for example an iphone and this was what the TPACK framework was trying to say (Koehler & Mishra, 2008). Pedagogy was explained to the PTs as "knowledge about teaching techniques and methods, the needs and preferences of the learners, the strategies used for student assessment, classroom management, lesson plan preparation and implementation (Koehler & Mishra, 2008). It was emphasized that pedagogy and content could not be separated from each other. They overlapped. Content was transformed by teachers for pedagogical purposes. "Teaching is about transforming disciplinary knowledge to meet the needs of the students" (Mishra & Koehler, 2010). By focusing on the relationship between content and pedagogy, PTs were introduced to the PCK. Following that other relationships between the separate constructs, i.e., TCK and TPK were explained. TCK referred to "the understanding of the manner in which technology and content influence and constrain one another" and it was mentioned that teachers should be aware of the relationship between technology and content: how specific technologies supported the learning of content best and how content dictated the use of specific technologies. TPK was explained as "understanding how teaching and learning changes when particular technologies are used" and as including the ability to creatively use available technology tools in a pedagogical context (Koehler & Mishra, 2008; Mishra & Koehler, 2010). Finally, the construct of TPACK was explained as a construct different from its individual components and their intersections. PTs were told that "it refers to the complex interrelationship between a teacher's technology use, instructional methods, and understanding of the subject matter" (Mishra & Koehler, 2010).

Following that discussion, PTs were asked what was missing in these discussions. They were introduced to the concept of "context" and told that none of the things discussed so far happened "in vacuum" but in a certain setting (Mishra & Koehler, 2010). They were presented different classroom setting examples and expected to discuss their implications in terms of technology integration. The aim was to show them how different setting would affect the implementations. With the addition of context, PTs were told that TPACK was considered as **T**otal **PACK**age and it was what teachers needed to have (Mishra & Koehler, 2010).

The classroom discussion continued with technology integration on three different levels: use, integrate and innovate. PTs were asked to give their opinions on each and then they were told that teachers' using technology did not mean that students learned well. The following issues were discussed in detail. Teachers' learning to teach with technology occurs in stages. The first stage begins with the mechanical level (technology use) at which teachers follow instructions explicitly and use the technology as it is intended by its programmer. In the second stage, teachers progress to the meaningful level (integration) and begin to think of alternative ways of using the technology. In the final stage of learning to teach with technology, teachers' practice reflects the generative level (innovation) in which they move away from traditional uses of technology, take into account their content and are aware of appropriate and inappropriate uses of technology (Zhao, et al. 2006). PTs were asked what generative level of TPACK looked like and then it was mentioned that TPACK at generative level implied repurposing of technology, working with constraints, teachers' becoming curriculum designers and creativity.

The next discussion topic was creativity and PTs were told that "creativity cannot be taught but it can be developed" (Mishra & Koehler, 2010). PTs were asked to work in small groups and talk about some examples of artful or creative teaching from their own student experience. They were given 5 minutes and then asked to share their examples with the rest of

the class. Following the examples shared by PTs, the instructor asked what made these examples creative for them. In other words, PTs were asked to find common features of the examples that were memorable to them. After brainstorming on their common features, it was mentioned that "creativity is a goal-oriented process of developing solutions that are **N**ovel, **E**ffective, and **W**hole (Mishra & Koehler, 2010). The meaning of each word was emphasized by giving examples. Finally, PTs were asked to go back to the examples they gave and decide if they were NEW, i.e., novel, effective and whole.

The discussion continued with the introduction of the term "design" which refers to "purposeful, iterative, reflective practice that seeks to bring together Technology, Pedagogy & Content in specific contexts" (Mishra & Koehler, 2010). The relationship between TPACK and design was made clear by telling PTs that "TPACK with its emphasis on the interaction teachers' knowledge of Content, Pedagogy, and Technology, places teachers front and center as designers, who flexibly and creatively integrate technology and pedagogical approaches to help their students understand subject matter" (Mishra & Koehler, 2010).

At the end of the lesson, PTs were given another small assignment (adopted from Mishra & Koehler, 2010). The assignment aimed to show them the importance of exploring-creating and –sharing. For the task, they were supposed to search letters in the environment, take their photos and form the words they like the best among the terms they have been learning for two weeks. The most common words they formed were explore, create, share, repurposing and TPACK.

The fourth week began with the focus on the photos PTs uploaded to the course blog. They explained why they specifically chose those particular words they created with photos of objects. Following that, PTs were asked how they would use this activity in language teaching for which grade level and how they would evaluate its success. PTs came up with several ideas such as asking students to create their slogan abut a topic or to choose their best word in

a novel they read by picturing its letters. They also suggested that this assignment can be used at the beginning of the term, by students, to say something about themselves.

For Week 4, PTs were assigned two articles for reading: "Too cool for school? No way!" (Mishra & Koehler, 2009) and "Looking back to the future of educational technology" (Mishra, Koehler & Kereluik, 2009). The aim was to revise what had been learned about TPACK so far.

The first article focused on TPACK and repurposing. In relation to repurposing, it discussed the conditions needed for teachers effective repurposing of technologies. The article also presented three examples of technology that can be repurposed for education-microblogging, visual search engines, and DJ softwares, all of which were developed by a team of Mishra's graduate students. The discussion on the theoretical part of the article was carried out by the PTs themselves. The examples given in the article were also examined in detail and PTs were asked whether and how they would use those three examples of technology for language teaching purposes.

The second article discussed the historical development of technology and emphasized its rapid change. The article supports the view that "Learning technical skills alone is not sufficient—learning how to integrate technologies into teaching is equally important" (p. 50) and discusses how teachers should be thinking in this world and emphasizes their role as curriculum designers. The article was also discussed by the PTs by focusing on the key issues. PTs were asked to think about and share the implications of the article for themselves as teacher candidates.

Following the discussions of the articles, PTs were informed that in the following two weeks (Weeks 5 and 6), they would be giving 10-minute presentations. 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. They

were asked to discuss how the tool could be used in language teaching and give or suggest one or two examples of its use. PTs were to finish the presentation by stating whether they would use it in their own teaching and give their reasons.

Before the groups were formed and PTs chose the technology they would work on, available technologies were brainstormed. The lesson ended with PTs' choosing their group members and the tool they would be exploring.

Weeks 5 and 6 were based on the collaborative presentations of PTs on the technological tools chosen. PTs, in groups of two or three, focused on the technologies such as blogs, wikis, digital storytelling tools, podcasts, You tube, Office Publisher Software, Facebook, Webquest, concordance, and Second Life (a simulation program). While demonstrating how to use these tools technically to their peers, PTs used power point or screen recording softwares. They also prepared handouts for their peers describing the use of each technology. Following that, PTs shared their examples of the use of the technologies for language teaching purposes and then there was a classroom discussion on other possible ways of using those technologies for language teaching.

At the end of Week 6, PTs were informed about their tasks for the remaining weeks of the study, when the coursework would be combined with the practicum. It was explained to PTs were explained that they 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.

One process in which TPACK may be seen in action is teacher planning (Yinger, 1979, cited in Richardson, 2009). Teacher knowledge and teacher planning are woven into the complexity of the classroom context (Mishra & Koehler, 2006). For the lesson planning process, PTs were to (1) choose a unit or part of a unit from the coursebook used in their practicum schools, (2) identify the problems in that unit by considering the needs of the

students in the classes they observe, (3) focus on one problem, (4) and come up with a solution in which they employ the appropriate technology.

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. For the planning, PTs were provided with a lesson plan format (Hamiloğlu, 2000) and complete it before teaching (see Appendix C).

The instructor provided PTs with some example lessons showing clearly what they were supposed to do for the following weeks.

In Weeks 7 and 8, PTs carried out peer teaching of the lesson plans they had prepared. They had 15-20 minutes for this purpose and they demonstrated the plans they would be teaching at their practicum schools. After each presentation, the instructor and the other PTs gave feedback and suggested modifications for the actual teaching.

For the feedback session following peer teachings, PTs were provided with a short training telling them what to focus on while observing each others' presentations. PTs were told to focus on how the technology chosen was used in presenting the lesson; to identify the teaching strategy used by their peers and decide if it was appropriate for the lesson and content and if it helped to engage students in learning English with technology; to identify any difficulties that might occur in presenting the content of the lesson; to describe how the lesson could accomplish (or not accomplish) the goal of the lesson; and what changes they would suggest to improve that lesson plan.

Following the feedback PTs received from their peers, they modified their plans and e-mailed the final version to the instructor for the final opinion.

During Weeks 9 and 10, PTs, after finalising their plans, did macro-teaching in their practicum schools. Six PTs selected as cases were observed by the instructor during their

practicum teaching for 40 minutes and given feedback afterwards. Other PTs video-recorded their lessons.

In Week 11, PTs gathered together to share their experiences of practice teaching with each other and with the instructor. They reflected on their experiences in their practicum schools and commented on each other's stories.

The course ended with the collection of the post data in Week 12 and overall evaluation of the course.

The following table summarizes the structure of the course. Since developing content knowledge or pedagogy knowledge was not the primary goal of this course, no specific hypotheses were made about the changes in the sub-scales of CK, PK, and PCK.

Table 2

The course structure

Weeks	Activities	The component(s) of TPACK addressed
1	- Pre-data collection - Introduction to the course - Discussion on the importance of technology integration in 21st century	
2	- Discussion on the importance of technology integration for ELT - Discussion on the meaning and different uses of technology - Introducing TPACK related terms: affordances, constraints, wicked problems, repurposing - A small assignment: Redefining a technology	TK, TPK
3	- Introduction to TPACK - Discussion on technology integration and design - A small assignment: Searching letters in the environment	TPACK, TPK, TCK
4	- Reading articles on TPACK - Revision	TPACK
5 & 6	- Collaborative presentations on various technological tools - Introduction to lesson planning	TK, TCK, TPK
7 & 8	- Peer teaching of the lesson plans	TPACK, CK, PK, PCK, TK, TCK, TPK
9 & 10	- Macro teaching at practicum schools	TPACK, CK, PK, PCK, TK, TCK, TPK
11	- Sharing experiences of macro teaching	TPACK
12	- Evaluation of the course - Post-data collection	

3.4. Data Collection Procedure

For the purposes of the present study, both quantitative and qualitative data were gathered. While the quantitative data were collected with the Survey of Pre-service Teachers' Knowledge of Teaching and Technology (Schmidt et al., 2009) (see Appendix E), the qualitative data came from written reflections, interviews, lesson plans, and classroom observations of the PTs. The fieldnotes of the instructor/researcher were used to triangulate the data.

3.4.1. The quantitative data.

For the quantitative phase of the study, a one-group pretest-posttest design (Patton, 2001) was used to examine the development of teachers' understanding of the relationships between technology, content, and pedagogy (Research Question 1). The following section describes the quantitative data collection instruments in detail.

3.4.1.1. The Survey of Pre-service Teachers' Knowledge of Teaching and Technology.

The Survey of Pre-service Teachers' Knowledge of Teaching and Technology, the TPACK survey (Schmidt, et. al., 2009), consisting of 47 questions refers to the categories of TPACK framework, i.e., technological knowledge (TK);, content knowledge (CK);, pedagogy knowledge (PK), pedagogical content knowledge (PCK), technological pedagogical knowledge (TPK), technological content knowledge (TCK) and technological pedagogical content knowledge (TPACK). Example items include "I know how to solve my own technical problems" (TK); "I have sufficient knowledge about mathematics" (CK); "I know how to assess student performance in a classroom" (PK); "I know how to select effective teaching approaches to guide student thinking and learning in mathematics" (PCK); "I know about

technologies that I can use for understanding and doing mathematics/literacy/science/social sciences" (TCK); I can choose technologies that enhance the teaching approaches for a lesson" (TPK); and "I can teach lessons that appropriately combine mathematics, technologies and teaching approaches" (TPACK). The internal consistency reliability of the survey ranged from .75 to .92 for the seven TPACK subscales.

PTs were asked to indicate the extent to which they agree with the statements related to their TPACK on a 5-point Likert scale ranging from 5 (strongly agree) to 1 (strongly disagree).

In addition to the components above, there were two more additional sections. The first section with eleven items asked whether the professors at university model combined content technologies and teaching approaches in their teaching. Finally, in the last section, PTs were asked some open-ended questions asking them to describe a specific episode where their university instructor, cooperating teachers and themselves effectively demonstrated or modelled combining content, technologies and teaching approaches in a classroom lesson.

The survey was adapted to the present study as the scale originally covers the content areas of social studies, mathematics, science and literacy. The adaptation of the items was limited to changing the content areas into English. For example the item "I have sufficient knowledge about mathematics" was changed to "I have sufficient knowledge about English." The adapted version included 29 items and it was piloted with 50 PTs in the same institution (see Appendix F). The Cronbach alpha reliability coefficient values were as follows: .78 (CK), .85 (PK), .76 (PCK), .81 (TPK), .75 (TCK) and .82 (TPACK). The open-ended sections of the survey were not used for the purposes of the study.

3.4.2. The qualitative data.

The qualitative data were obtained from the written reflections, interviews, lesson plans and classroom observations of PTs and were supported by the fieldnotes of the instructor/researcher. While the data coming from the written reflections and interviews were were collected to answer the first research question, data for the second research question came from the lesson plans and classroom observations of PTs.

3.4.2.1. Reflections.

Throughout the study, PTs were asked to reflect on a case, on their lesson plans, on their teaching experience at the practicum and on the study they participated.

3.4.2.1.1. The case.

PTs were given a case to comment on at the beginning and end of the study. The aim was to see whether there would be a change in PTs' understanding of TPACK. The case given to PTs was taken from Cox and Graham (2009) (see Appendix D). It focused on the use of blogs by a history teacher in order to increase the understanding and reflection of learners on world events. PTs were asked to read the case and reflect on it by focusing on the technology use of the teacher.

3.4.2.1.2. Lesson plans.

Written reflections of PTs also provided information concerning their lesson planning process- how they planned their instruction, what they thought about it, what type of decisions they made, on what they focused their attention, i.e., the technology itself, other aspects of their practice, or some combinations. Lazaraton and Ishihara (2005) state that the self-reflection of teachers is an effective tool in revealing various factors of teacher knowledge

and practice. It provides insights into what teachers bring to bear on the understanding of their own classroom practices and promotes the construction of teacher's knowledge of their own practice.

Throughout the study, PTs were asked to prepare lesson plans twice: One on a topic of their choice and one to teach at their practicum school.

For the first lesson plan, PTs, at the beginning of the study, were asked to design a lesson in which they integrate a specific technology or combination of technologies. For their planning, PTs were given the following instructions:

> Plan a lesson in which you integrate a specific technology or combination of technologies. In your plan, state the grade level that you would be teaching, the content you want to focus on (what you want to teach), and the teaching approach(es) you would implement (how you want to teach) as well as your objective(s). In your plan, write in detail, how you would use the technology you have selected for your lesson.

Following their planning, PTs were asked to reflect on their plans. At the end of the study, PTs were given the plans they prepared before and asked to reflect on their plans again.

The second lesson planning took place when the coursework was combined with fieldwork. PTs were asked to design a lesson based on the coursebook used in their practice school. As data, PTs submitted the first version of their lesson plans, the modified version of the plans demonstrating the changes they made, and the materials they prepared for the lessons they designed. The aim of collecting the lesson plans was to explore how the PTs moved among and combined different types of knowledge to make decisions about the technologies, pedagogies and content that would be part of planned learning experiences for students.

In relation to the lesson planning for practice teaching, PTs were asked to write three reflections: reflection on their lesson plans before peer-teaching, reflection on their plans after they receive feedback from their peers and the instructor; and reflection on their macro-teaching at their practicum schools.

For each reflection, PTs were given some guiding questions to focus on but they were not limited to those questions. For the reflection they were supposed to write on their lesson planning before peer-teaching, PTs were given the following questions: What were the problems that you identified in the course book unit?; Why did you choose that particular problem to solve?; Why did you choose that particular technology? Which factor(s) affected your decision?; How does your plan use technology?; What kind of instructional strategy does your plan use? On what content does your plan focus? What types of things did you consider while you were planning your lesson? What are the difficulties you might have while teaching your plan?

For the second reflection that PTs wrote after they received feedback on their plans, the questions given were: What kind of feedback did you receive from your instructor and your peers?; Do you agree with them?; What kind of changes are you planning to do in your lesson plan?; What do you think about the feedback process? Do you find it helpful, etc.?

The third reflection of PTs focused on their teaching in their practicum schools. PTs were asked the following questions: How do you think your lesson went? Did it go as you planned?; Were there any problems that you had to fix while teaching?; What do you think about the students' opinions on your lesson? Did they enjoy it? Did they find using technology difficult/enjoyable, etc.?; Did you accomplish your goal? Did students learn what you aimed for them?; Do you think your lesson facilitated your students' learning that particular content?; Is there anything that you want to improve about your lesson plan? PTs

were also asked to write about their thoughts and feelings as they had implemented their plans.

3.4.2.1.3. The study.

In addition to the reflections focusing on the planning and implementation processes, PTs were also asked to reflect on the whole research process at the end of the study. They were asked to evaluate the coursework, whether they thought they developed a specific knowledge of technology use, i.e., TPACK; from which activities they benefited the most throughout the term; what they thought of the role of the researcher in that process; whether they had any suggestions on the implementation of the coursework they participated in; and how they felt about their use and integration of technology as teacher candidates to become teachers in few months.

3.4.2.2. Interviews.

Another data source was the interviews. The interview set consisted of two individual interviews for 6 cases: before and after macro teaching at practicum schools. Merriam (1998) classifies interviews by their degree of structure. She presented a continuum from highly structured/standardized to semi-structured to unstructured /informal (p.73). The interviews of this study fell on the continuum between highly structured/ standardized to semi-structured.

The researcher used PTs' written reflections and her observational fieldnotes as starting points for the interviews. The tone of the interview was fairly conversational and informal. Patton (1990) lists three categories of questions for the qualitative research: experience, feeling, and knowledge questions. The questions asked in this study fell under these categories. During the interviews, the researcher also used prompts, or exploratory questions, as suggested by Seidman (1998) in order to elaborate on the information given by the PTs.

The first interviews were conducted just before PTs did macro teaching at their practicum schools. The individual interviews provided a personalized opportunity to explore the story of each preservice teacher in greater detail and to examine the factors influencing their decisions to integrate a particular technology in their teaching.

The researcher began the interview by asking some general questions about their technology use. The questions asked were as follows: Have you had an opportunity to employ any technology during your fieldwork as a PT before? Why? Why not? Can you describe in detail some specific examples of how you have used technology in the classroom? Why did you choose to use technology in these ways?; How does technology influence your instructional methods and the content you are able teach?; How do you think your students use technology either in and out of school? In addition, PTs were asked to give some information about their practicum schools and the classrooms they had been observing.

After those introductory questions, PTs were asked to describe their lesson planning process: How their plans used technology, what kind of instructional strategies they were planning to use while teaching, on what content their plans focused on were the questions asked to make them reflect on their plans. They were also asked how they prepared themselves and their classroom for using technology and to describe the factors that either hindered or supported their decision to use technology. PTs were also asked specific questions, different from each other, depending on their lesson plans. Finally, they were requested to talk about their expectations, thoughts and feelings in relation to the implementation of their plans.

Immediately after the implementation, PTs were asked what worked or did not work in their plans; how the students in their classes reacted to the learning activities designed for them; whether they would consider making any changes in their plans if they were to implement their plans again and if yes, what type of changes they would make; what they

thought and how they were feeling as they had implemented their plans. Specific issues were raised by the researcher based on her observational fieldnotes of PTs micro teaching.

Each interview lasted 10-15 minutes and was audio-recorded. For each participant, the interview data was transcribed and the transcribed data were analyzed prior to the next interview.

3.4.2.3. Lesson plans.

Lesson plans of PTs were collected to answer the second research question. As discussed above (see section 3.4.2.1.2), PTs designed a lesson, modified it based on the feedback from their peers and the instructor, and taught it at their practice schools. Before planning, PTs were provided with a lesson plan format (Hamiloğlu, 2000) (see Appendix C) and final versions of their lesson plans were collected for analysis.

3.4.2.4. Observational data.

In order to compensate the gap between words and actions, observational data were also collected. Observations of the 6 cases were conducted during the spring semester of 2010 at the schools where the participants completed their field experiences. Observations were arranged with each preservice teacher. The researcher observed 40-minute period of instruction for each preservice teacher. The observations focused on the ways in which the PTs integrated technology in their instruction and on the issues relevant to research questions.

Observing PTs' classroom practice helped the researcher understand how they acted in their lessons with respect to TPACK. The lessons undertaken by PTs were also video recorded for further analysis.

3.4.2.5. Fieldnotes.

Data for the present study also came from the fieldnotes. The researcher kept both descriptive and reflective fieldnotes in relation to coursework and fieldwork as recommended by Bogdan and Biklen (1998). Descriptive fieldnotes represent "the researcher's best effort to objectively record the details of what has occurred in the field" (Bogdan & Biklen, 1998, p. 121). Reflective fieldnotes, on the other hand, "contain sentences and paragraphs that reflect a more personal account of the course of the inquiry" (Bogdan & Biklen, 1998, p. 123). As the researcher is so central to the collection and analysis of the data, being self-reflective and keeping the record of methods, procedures and analysis accurately is very important. Following the suggestions of Bogdan and Biklen, the researcher of the present study carefully documented her personal biases, assumptions, and feelings in the reflective part of the fieldnotes "to improve the notes."

In relation to coursework, the researcher kept detailed notes immediately after each meeting both focusing on the description of the lesson (descriptive) and on her own comments (reflective). Descriptive notes referred to the materials used, PTs' participation or comments, events occurring during the lessons, as well as the date of the lesson, its time and duration. Reflective notes, on the other hand, focused on the feelings, ideas, comments, impressions, prejudices and problems of the researcher.

For the fieldwork, the researcher took fieldnotes for observations of PTs' macro teaching experience at school sites. The descriptive part of the fieldnotes for the observations included information on (a) the location, date and time of the observation; (b) description of the physical setting in terms of the space and seating arrangement, technology available and its location in the classroom; (c) description of the lesson in detail referring to the people and accounting of particular events. The reflective part focused on the researcher's beliefs,

feelings and opinions on how the lesson went, what worked/did not work well, and whether the pre-service teacher proved TPACK.

3.4.2.6. Supplementary materials.

In addition to the data mentioned above, supplementary materials such as the coursebook units on which PTs prepared lesson plans, handouts or other materials accompanying the plans, and materials produced by the students during the macro teaching of PTs were also collected. The aim was to better understand whether and how PTs developed their TPACK.

3.4.2.7. Trustworthiness.

The present study used the trustworthiness criteria as suggested by Lincoln and Guba (1985) to evaluate the scientific quality of the qualitative part of the research. Lincoln and Guba proposed four criteria that should be considered by qualitative researchers in pursuit of a trustworthy study: credibility, transferability, dependability, and confirmability.

3.4.2.7.1. Credibility.

Guba and Lincoln argue that ensuring credibility is one of most important factors in establishing trustworthiness and it refers to "the match between the constructed realities of respondents (or stakeholders) and those realities as represented by the evaluator and attributed to various stakeholders" (1989, p. 237). In order to ensure credibility in the present study, the following techniques were employed: Prolonged engagement (Guba & Lincoln, 1989); triangulation (Patton, 2002); peer debriefing (Guba & Lincoln, 1989); peer scrutiny of the research project (Shenton, 2004); progressive subjectivity (Guba & Lincoln,

1989); background, qualifications and experience of the investigator (Patton, 2002); and member checks (Guba & Lincoln, 1989).

Prolonged engagement requires the researcher to establish rapport and trust with the participants in order to understand their perceptions. As the researcher of this study had been the instructor of the participating pre-service teachers in a number of courses before, the rapport and trust was already established between them. In addition, the researcher's engagement in the study as the instructor through direct contact with the participants and the context allowed for a careful observation of the nature of technology related knowledge development.

Triangulation refers to "gathering and reconciling of data from several sources and/or from different data gathering techniques" (Lynch, 1996, p. 59). Multiple source triangulation can take different forms. Data can be gathered (a) from various program participants such as teachers, students, administrators; (b) from different settings such as inside and outside the classroom and (c) from different times such as before and after examinations (Lynch, 1996). In the present study multiple source triangulation was achieved by collecting data from two different settings, i.e., university and practicum schools. In addition, data were collected at the beginning of the study, before the coursework started, at the end of the study, after the coursework was completed, and during the study. For the methodological triangulation, the data were gathered from multiple sources including field observations, field notes, interview transcripts, written reflections and artefacts.

Peer debriefing was also used to ensure credibility. It refers to the discussion of the study with colleagues who are not directly involved in the study. Such discussions were carried out during this study with the members of the dissertation committee who were experts on the methods and the content of the study. Their comments helped the researcher to see the flaws in the course of action and to recognize her own biases.

In order to benefit from peer scrutiny, the present study was presented at a post-graduate conference made over the duration of the study. Comments, suggestions and recommendations received helped the researcher to refine her methods, explain her research design more clearly and see her work more objectively.

Through keeping field notes and writing reflective commentaries, the researcher accomplished "progressive subjectivity" which is considered to be critical in establishing credibility (Guba & Lincoln, 1989). Progressive subjectivity is based on the comparison of developing constructions to the initial constructions of the researcher.

According to Patton (2002), background, qualifications and experience of the investigator are important in qualitative research as the researcher is considered to be the major instrument of data collection and analysis. Thus, in the present dissertation, the researcher included personal and professional information relevant to the phenomenon under study.

Guba and Lincoln (1989) discuss that member checking which is related to the accuracy of the data also improves credibility. In the present study member checking was done by asking pre-service teachers to confirm the researcher's understanding of what they said during the interviews or in their reflective writings.

3.4.2.7.2. Transferability.

Transferability is the second criteria of trustworthiness and is defined as "the degree of similarity between sending (the original evaluation or study) and receiving (the context to which generalization is desired) contexts" (Guba & Lincoln, 1989, p. 237). It is also described as "case-to-case transfer" (Schwandt, 2001, p. 258) and thick description is the technique recommended to accomplish it (Guba & Lincoln, 1989). For the achievement of transferability in the study, the researcher provided detailed contextual information about the

research sites so that the phenomenon investigated can be compared and transferred to similar situations.

3.4.2.7.3. Dependability.

Dependability refers to "the stability of the data over time" (Guba & Lincoln, 1989, p. 242). They suggest dependability audit which refers to detailed documentation of the processes in a study in order to ensure dependability. Such a report would help the reader to understand the methods for gathering and analyzing data in detail, thereby enabling their replication of the study. In the present dissertation, the research design and its implementation as well as the process of data collection and analysis are extensively described with the aim of achieving dependability.

3.4.2.7.4. Confirmability.

Confirmability is defined by Guba and Lincoln (1989) as being "concerned with assuring that data, interpretations, and outcomes of inquiries are rooted in contexts and persons apart from the evaluator and are not simply figments of the evaluator's imagination" (p. 243). In other words, the findings of a study should be the results of the experiences and opinions of the participants not the preferences of the researcher (Shenton, 2004). The methods of triangulation, detailed methodological descriptions and comfirmability audit are the techniques recommended to promote comfirmability. Triangulation used in the present study, as discussed above, helps to reduce the effect of researcher bias in the context of comfirmability. In addition, fieldnotes and the reflective comments of the researcher provide a detailed account of the predispositions, decisions and thought processes of the researcher. Detailed description of the methodology in this study also helps the reader to determine how far the data and the conclusions drawn may be accepted, thereby achieving confirmability

audit techniques which “assumes that the data and the process by which the conclusions were drawn are available for inspection by an outside reviewer” (Guba & Lincoln, 1989, p. 243).

3.5. Data Analysis Procedure

3.5.1. The quantitative data.

As mentioned in the previous chapters, the aim of the quantitative phase of the present study is to provide an account of PTs’ self-reported levels of technology related knowledge components of TPACK, i.e., TK, TCK, TPK and TPACK and to examine the development of their understanding of the relationships between technology, content and pedagogy throughout the study.

Statistical Package for the Social Sciences (SPSS) 14.0 was used to analyze the quantitative data coming from the TPACK survey (Schmidt, et. al., 2009). Following the entry of the pre- and post-survey responses of the participants into the database, the data were checked for accuracy.

As explained in the methodology section above, the self-report items of the TPACK Survey used a five point Likert Scale to rate the extent to which PTs of English agreed or disagreed with the statements about their beliefs on the relationships between technology, pedagogy and content. In order to understand PTs’ self-perceived technology related knowledge, descriptive analyses were carried out on the data. As Pallant has discussed, prior to statistical tests, descriptive analyses should be carried out in order to check that assumptions made by the individual tests are not violated. Testing of assumptions involves obtaining descriptive statistics such as mean, standard deviation, skewness and kurtosis on your variables (Pallant, 2005).

As the sample size of the present study is small and normality is questionable, a histogram, P-P plot, and Q-Q plots were drawn, skewness and kurtosis values were obtained

in order to assess the normality of the distribution scores (see the following section for the analyses and the actions taken).

Following that, Dependent means *t*-test (or paired-samples *t*-test) was used to analyze the pre- and post-test differences in each subscale of the survey. The aim was to understand whether PTs' beliefs changed after participating into the present study. Pre- and post-test experimental designs are an example of the type of situation where dependent t-test technique is appropriate (Pallant, 2005). For the pre- and post-test differences in each sub-scale, *t*-statistics, *p*-values and eta squared measures were calculated.

3.5.2. Connecting the quantitative phase to the qualitative phase of the study.

The quantitative phase of the present mixed methods study helped to understand PTs' self-perceptions of their TPACK and to examine the development of their understanding of the relationships between technology, content and pedagogy throughout the study. In order to purposefully identify information-rich cases for the qualitative phase of the study, first, the individual participants' raw scores for TPACK were transformed into z-scores. Then, the algorithm of one standard deviation above or below the mean was applied using z-scores of the technology related knowledge domains subscales. Based on their scores, PTs were divided into three groups. PTs whose mean scores were one or more standard deviations below the mean were judged to have low level of TPACK; those whose mean scores were one or more standard deviations above the mean were considered to have high levels of TPACK; and the rest was judged to have an average or medium level of TPACK. Finally, based on the information received, a total of six PTs were selected from each level, i.e., low, medium and high- two from each. They all agreed to participate in the qualitative phase of this study.

3.5.3. The qualitative data.

In the present study, qualitative analysis was conducted to answer the two research questions. For the first research question, in order to investigate the change that occurs in TPACK and its components in detail, the data collected from the six cases throughout the study were analyzed using qualitative content analysis. For the second research question, lesson plans and observational data of the six cases were analyzed using the Technology Integration Observation Instrument, developed by Harris, Grandgenett, and Hofer (2010), in order to see how PTs' TPACK is reflected in their instructional practices.

3.5.3.1. Qualitative content analysis.

The methodology used for the in-depth analysis of the first research question of the present study was qualitative content analysis. Content analysis historically has been quantitative in nature and defined as "a research technique for the objective, systematic, quantitative description of the manifest content of communication" (Berelson, 1952, p. 519). The units of measurement in quantitative content analysis centre on communication and the analysis focuses on the frequency and variety of messages (Manning & Cullum-Swan, 1994, cited in Merriam, p. 160).

Krippendorff (2004) defines content analysis as "a research technique for making replicable and valid inferences from texts (or other meaningful matter) to the context of their use" (p. 18). Weber (1990) states content analysis helps to reveal and describe the focus of individual, group, institutional and/or social attention and to identify the patterns in communicative content. "A central idea in content analysis is that the many words of the text are classified into much fewer content categories." (Weber, 1990, p. 12).

Quantitative content analysis has been transferred to qualitative research with some changes (Merriam, 2002). Qualitative content analysis has been defined as "a research

method for the subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns" (Hsieh & Shannon, 2005, p.1278). Mayring (2000, p. 2) calls it as "an empirical, methodological controlled analysis of texts" and Patton adds that "it attempts to identify core consistencies and meanings" (p. 453). Merriam (2002) states that "all qualitative data analysis is *content* analysis in that it is the content of interviews, field notes, and documents that is analyzed" (p. 160).

Zhang and Wildemuth (2009) discuss that, in comparison with the quantitative content analysis, qualitative content analysis goes beyond counting words or taking their frequencies in a text to focus on and examine the meanings, themes and patterns that might be inherent in a particular text. The researcher can understand the social reality subjectively but scientifically. While quantitative content analysis focused on the objective and quantitative description of the data, qualitative content analysis was developed in anthropology, qualitative sociology and psychology with the aim of understanding the meaning underlying communications. Quantitative content analysis required the selection of the data using some statistical approaches such as random sampling in order to ensure validity. On the other hand, qualitative content analysis used purposively selected texts which provide the most useful and explanatory data for the research questions investigated. The two approaches are also different in terms of their products. The product of quantitative content analysis is numbers to be studied statistically while the qualitative approach produces descriptions of the data with expressions of the subjects reflecting their meanings. Finally, quantitative content analysis is deductive. It aims to test hypotheses or answer questions based on previous empirical research. By contrast, qualitative content analysis is mainly inductive, "grounding the examination of topics and themes, as well as the inferences drawn from them, in the data" (p. 1).

Although qualitative content analysis is mainly inductive, it can also include deductive reasoning (Patton, 2002). Mayring (2000) states that "deductive category application works with previously formulated, theoretically derived aspects of analysis, bringing them in connection with the text." The qualitative step of analysis consists of a methodological controlled assignment of the category to a passage of text. The following figure shows the steps of deductive category application as suggested by Mayring (2000):

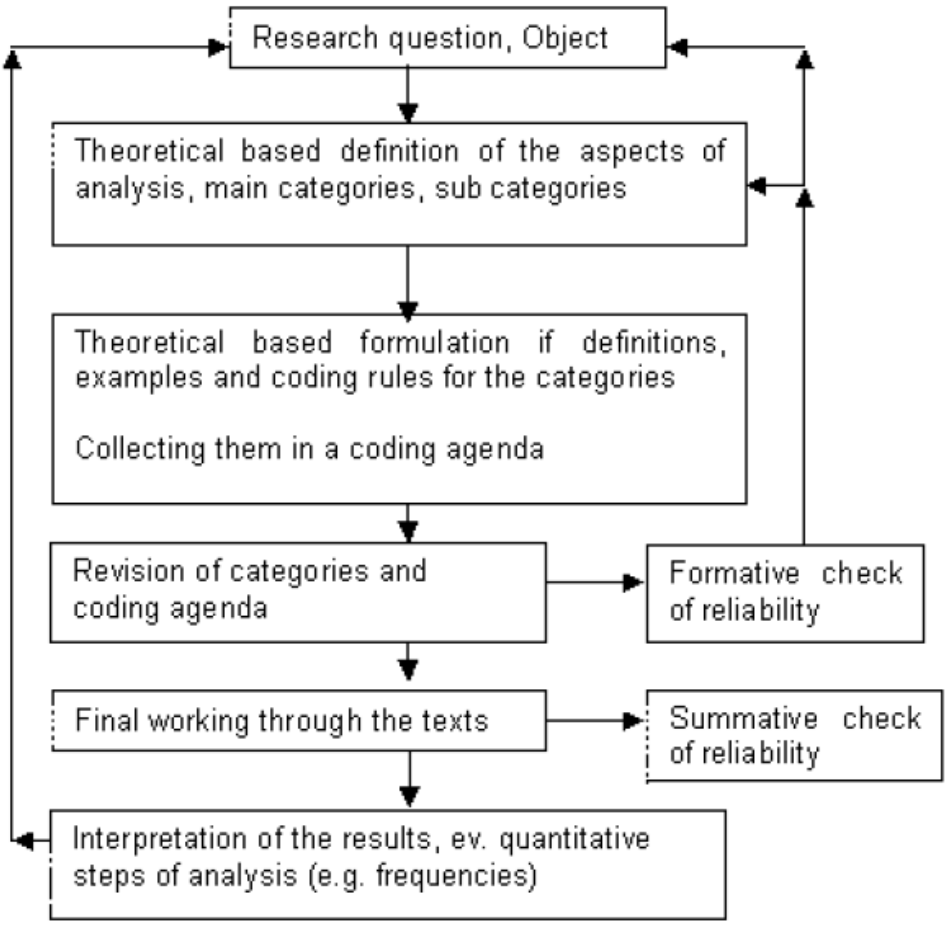

Figure 8. Step model of deductive category application (adopted from Mayring, 2000).

Based on his model, Mayring says that the main idea of the analysis process above is to give explicit definitions, examples and coding rules for each deductive category, determining exactly under what circumstances a text passage can be coded with a category.

Zhang and Wildemuth (2009) also suggest a set of systematic procedures for the process of qualitative content analysis which begins in the early stages of data collection. The first step they state is "preparing the data." The preparation of the data refers to transformation of the data into written text before analysis can begin. The second step is "defining the unit of analysis" which refers to "the basic unit of text to be classified during content analysis."

"Developing categories and a coding scheme" is the third stage of analysis. They mention that categories and a coding scheme might come from the data itself, previous related studies and theories. Thus, coding schemes can be both inductively and deductively developed. They discuss that inductive content analysis is appropriate for the studies which aim to develop a theory rather than to describe a particular phenomenon or verify an existing theory. Deductive content analysis is, on the other hand, appropriate for the studies based on a preliminary model or theory.

In relation to the developing categories and coding schemes, Miles and Huberman (1994) also state that an initial list of coding categories might be developed from a model or a theory and the model or theory might be modified during the process of analysis as new categories emerge inductively from the raw data. Dörnyei (2007) cites Crabtree and Miller (1999) who describe a coding method called "template organizing style." According to their method, the first step of data analysis begins with the preparation of a template, or code manual, and the data is coded using this template. Dornyei (2007), in relation to the template model, discusses that this method can only be applied if there is sufficient background information on the topic to be able to define the categories in the template. Zhang and Wildemuth (2009) add that the coding scheme prepared in advance helps to compare the research findings across relevant studies. In relation to the development of a coding scheme, Mayring (2000) and Weber (1990) emphasize the importance of giving explicit definitions,

examples and the coding rules for each deductive category to be used in a study especially when multiple coders are involved.

Step four in the model of Zhang and Wildemuth is "testing the coding scheme on a sample of text." They suggest the development and validation of the coding scheme early in the process. The clarity and consistency of the coding scheme might be tested by coding a sample of your data. Following the sample coding, the consistency of the coding should be checked through inter-coder agreement. In the case of any inconsistency, the scheme should be revised to reach the maximum level of consistency.

After reaching an agreement on the coding scheme, "coding all the text" comes as the next step in the analysis process suggested by Zhang and Wildemuth. The coding procedure is applied to the entire set of data and during the process new themes and concepts might be added to the coding scheme as they emerge in the data.

"Assessing the coding consistency" of the data is the sixth step to be followed in the model. As the coding of the whole data should be consistent, the coding consistency of the data set needs to be rechecked. "Drawing conclusion from the coded data" follows the consistency check (Zhang & Wildemuth, 2009). This stage depends on making inferences of the themes or categories that were identified, exploring their relationships, and "reconstructing meanings derived from the data" (p. 6).

Final step is "reporting the methods and findings." As Zhang and Wildemuth discuss, the decisions and practices regarding the coding process and the techniques used to address the issue of trustworthiness should be reported in detail so that the study becomes replicable.

In relation to the application of a coding scheme, Weber (1990) also discusses that certain steps must be followed for the application of a coding scheme. The first step is "defining the recording units" which refers to the definition of the basic unit of text to be coded for themes and content. Commonly used options are word sense, concept, sentence,

theme, paragraph and whole text. Step two is "defining the categories" to be used during the process of coding followed by the "testing of coding on sample of text." Step four in his model is "assessing accuracy and reliability" of the coding process. Based on the reliability value, the coding rules must be revised, which is step 5. Step 6 involves the revision of the modified coding rules followed by "coding all the text" which is step 7. Finally, his model recommends "assessing achieved reliability or accuracy" (pp. 22-24).

The combination of qualitative and quantitative methods for content analysis is suggested to provide greater insight into the study conducted (Mayring, 2000; Zhang & Wildemuth, 2009). Weber (1990) states that the best content analytic studies are the ones combining qualitative and quantitative operations.

Based on the discussion above, the following 9-step procedure was adapted for the present study:

Step 1: The qualitative data analysis process of the present study began with the preparation and organization of the data coming from the selected six cases in chronological order, beginning with their written reflection on the given case, followed by the reflection on the first lesson plan they prepared on a topic of their choice. This was followed by the three reflections: one on the first version of the lesson plan they prepared to be taught in their fieldwork; one on the feedback they received on their plans; and one on their micro-teaching at their practicum schools. Then came the audio recordings of the interviews conducted before and after their micro-teaching and video-recordings of their micro-teaching of the modified lesson plans. Final data set included the written reflections of PTs on the given case at the beginning of the study and on their first lesson plan and their overall evaluation of the study they participated in. The researcher fieldnotes were used to triangulate the findings coming from the abovementioned data.

Step 2: For the analysis of the data, NVivo 8.0, a software application which can be used to analyze multimedia linguistic data and complete in-depth analysis of text, was employed. NVivo allows the researcher to create nodes, i.e., codes, and to highlight and code pieces of text (QSR International, 2008). Thus, the complete qualitative data to be analyzed were transferred to the software for the analysis.

Step 3: The next step in the present study was defining the units of analysis as recommended by many researchers (e.g., Weber ,1990; Zang and Wildemuth, 2009; Rourke et al. 2001). Individual themes rather than syntactical units such as words, sentences or paragraphs were used as the units for analysis, which is usually the case in qualitative content analysis (Zang & Wildemuth, 2009). A code might be assigned to a chunk of text which is of any size such as a word, phrase, a sentence, a paragraph or the entire document as long as that particular text chunk represents a theme or issue relevant to the study (Zang & Wildemuth, 2009). For the purposes of the present study, thematic units or as called by Henri (1991) "unit of meaning" were identified as the units of analysis.

Step 4: Following the definition of the unit of analysis, coding protocols consistent with the TPACK framework was developed. Coding of the data using the TPCK framework helped to identify findings related to what changes in the TPACK and its components occurred. The next section provides a brief overview of each of the TPACK constructs used in the coding process for this study.

Step 5: As the fourth step in the analysis, the coding scheme developed was tested on a sample of text. First, the researcher of the present study coded the sample text using the coding scheme based on TPACK framework. Following her, the same sample of text was coded by a colleague of her who received brief training on the TPACK framework and the coding rules for reliability purposes. Weber (1990) states that "to make valid inferences from the text, it is important that the classification procedure be reliable in the sense of being

consistent. Different people should code the same text in the same way" (p. 12). For the present study, the inter-rater reliability was 91 %.

Step 6: The next step was the coding of the entire data set. Each text coming from the cases was read through several times and then coded using the coding scheme. During the analysis of the data, the researcher aimed to identify PTs' knowledge development related to the TPACK framework. Establishing a priori codes of CK, PK, TK, TCK, TPK and TPACK helped the researcher focus on certain data and ignore the other.

Step 7: When the data analysis was completed by the researcher, the same procedure was followed by a colleague for reliability purposes.

Step 8: When the coding process was over, a systematic quantitative analysis of the occurrence of TPACK and its components was conducted to determine the nature and development of interaction patterns of PTs during their participation to the present study as suggested by Koehler, Mishra and Yahya (2007).

Step 9: As the final step, the research findings were reported for each case following the research questions to be answered in the present study.

3.5.3.1.1. Coding protocols.

For qualitative content analysis, coding protocols consistent with the TPACK framework was developed. Coding of the data using the TPACK framework helped to identify findings related to what changes in TPACK had occurred. The following section provides a brief overview of each of the TPACK constructs used in the within-case coding process for this study. The data were coded for each construct of TPACK although basically the technology related knowledge components of the TPACK construct are discussed in relation to the first research question.

CK codes. Content knowledge, in general, refers to subject-area knowledge. As Koehler and Mishra (2008) define it CK is "knowledge about the actual subject matter that is to be learned or taught" (p. 31). As Cox and Graham (2009) state "this knowledge is independent of pedagogical activities" (p. 63). In a number of their studies, Koehler and Mishra discuss that CK across the field shows great differences and it is critically important for teachers to have a comprehensive base of CK of the discipline in which they teach (Koehler & Mishra, 2008; Mishra & Koehler, 2006). In relation to the content knowledge of teachers, van Olphen (2008) states that CK for language teachers includes;

- language specific linguistics (morphology, phonetics, phonology, pragmatics, second language acquisition, semantics, socio-linguistics, and syntax), and
- the development of both cross-cultural awareness and near-native language proficiency (p. 110).

Van Olphen adds that CK for language teachers ideally includes "all the necessary elements that help language learners to communicate both verbally and nonverbally across linguistic and cultural borders" (p. 110).

Thus, in the data analysis of the qualitative data, comments of the PTs which reflected their subject specific knowledge of English including *language specific linguistics*, *cross-cultural awareness* and *language proficiency* were coded as CK.

PK codes. Pedagogical knowledge is defined by Koehler and Mishra (2008) as the knowledge about teaching and learning processes and practices and it includes educational purposes, goals, values, strategies and more. They elaborate on their definition and add that PK "is a generic form of knowledge that applied to student learning, classroom management, lesson plan development and implementation, and student evaluation" (p. 14). As they

emphasize, PK is independent of a specific content. Based on their definitions and discussions, PTs' comments were coded as PK when they focused on and/or reflected;

- *the knowledge about student learning,*
- *knowledge about techniques or methods used in the classroom,*
- *the nature of the target audience,*
- *classroom management,*
- *lesson plan development,*
- *lesson plan implementation, and*
- *student evaluation.*

TK codes. Technological Knowledge is used to refer to the ability of using digital and non-digital technologies. A person with a TK can achieve a variety of different tasks such as installing and removing devices, software programs or creating and archiving documents and can develop different ways of accomplishing a given task (Koehler & Mishra, 2008). For the purposes of the present study, PTs' comments which reflected their *ability in using digital technologies* were considered as the indicator of their TK.

PCK codes. Pedagogical Content Knowledge, in the TPACK framework, is based on the idea of Shulman (1987) who defines it as knowledge of pedagogy that is applicable to the teaching of specific content. Koehler and Mishra (2008) explain PCK as the "core business of teaching, learning, curriculum, assessment, and reporting, such as the conditions that promote learning and the links among curriculum, assessment, and pedagogy" (p. 14). PCK includes "the representation and formulation of concepts, pedagogical techniques, knowledge of what makes concepts difficult or easy to learn, knowledge of students' prior knowledge and theories of epistemology" (Koehler, Mishra & Yahya, 2007, p. 743).

Van Olphen describes PCK of language teachers as "what teachers know about teaching the target language to empower students to communicate across linguistic and cultural borders" (p. 112). Based on these definitions of PCK, PTs' comments were coded as PCK when they reflected on;

- *the knowledge of students' prior knowledge,*
- *alternative teaching strategies in language teaching,*
- *the representation and formulation of concepts of language learning,*
- *pedagogical techniques specific to language teaching, and*
- *knowledge of what makes concepts difficult or easy in learning a language*

in order to improve the effectiveness of the lesson.

TCK codes. Technological Content Knowledge (TCK) is primarily concerned with the relationship of technology to a particular content. Koehler and Mishra define it as "an understanding of the manner in which technology and content influence and constrain one another" (Koehler & Mishra, 2008, p. 16).

The following definitions of TCK by Koehler and Mishra exist in the literature

- "Understanding the impact of technology on the practices and knowledge of a given discipline" (Koehler & Mishra, 2008, p. 16)
- Understanding how technology and content are interconnected and how they influence and constrain one another (Koehler & Mishra, 2005, 2008)
- Knowing "which specific technologies are best suited for addressing subject-matter learning" (Koehler & Mishra, 2008, p. 16).
- Knowing how the subject matter can be changed by the application of technology (Koehler & Mishra, 2006).

TCK specific to language teachers is described by Koehler and Mishra (2005) as

knowing how technology is used to represent the content knowledge, i.e., the knowledge of target language and its culture (Koehler & Mishra, 2005). Van Olphen (2008) defines TCK specific to language teachers as "the body of knowledge that teachers have about their target language and its culture and how technology is used to represent this knowledge (p. 113).

Based on these definitions, the following components were used in the coding process of TCK:

- *the representation of content, i.e., the knowledge about the target language and its culture, with technology,*
- *the changes in the content as a result of using technology,*
- *the changes in the technology due to the content.*

TPK codes. Koehler and Mishra (2008) conceptualize TPK as "an understanding of how teaching and learning changes when particular technologies are used" (p. 16). TPK involves the "knowledge of the existence, components, and capabilities of various technologies as they are used in teaching and learning settings" (Koehler & Mishra, 2006, p. 1028). In their definitions of TPK, Koehler and Mishra emphasize the importance of knowing the affordances and constraints of technological tools when used for pedagogical purposes and add that "this requires getting a deeper understanding of the constraints and affordances of technologies and the disciplinary contexts within which they function" (Koehler & Mishra, 2008, pp. 16-17). In addition to knowing the affordances and constraints of technological tools, Koehler and Mishra also emphasize the role of creativity and say that teachers need to think creatively in order to be able to repurpose technological tools for pedagogical purposes (2008). The following quotations illustrate their point:

> "an important part of TPK is developing creative flexibility with available tools in order to repurpose them for specific pedagogical purposes." (Koehler & Mishra, 2008, p. 17)

> "TPK requires a forward-looking, creative, and open-minded seeking of technology, not for its own sake, but for the sake of advancing student learning and understanding." (Koehler & Mishra, 2008, p. 17)

> "The pedagogy of how to use and apply the technology is technological pedagogical knowledge."

Koehler and Mishra discuss that TPK becomes particularly important as most software programs such as The Microsoft Office Suite and web-based Technologies such as blogs or podcasts are not designed for educational purpose, teachers need to "reconfigure" them for their pedagogical purposes creatively and open-mindedly (2008, p. 17).

Based on the definitions of TPK, the following components were selected to be used in the coding process of TPK: K*nowledge of the pedagogical affordances and constraints of technological tools, repurposing,* and *considering student learning.*

TPACK codes. As defined by Koehler and Mishra, TPACK is different from three individual knowledge types and it refers to "an understanding that emerges from an *interaction* of content, pedagogy, and technology knowledge" (2008, p. 17). The following quote gives a comprehensive account of the construct:

> TPACK is the basis of effective 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 (pp. 17-18).

They argue that the three components "exist in a state of dynamic equilibrium" (p. 18) and "teaching successfully with technology requires continually creating, maintaining, and re-establishing a dynamic equilibrium between each component" (p. 20).

Koehler and Mishra emphasize that TPACK is not a simple combination of the three domains. Instead they are interdependent and affect each other. Thus, in the TPACK of teachers, the individual components cannot be observed in isolation but in interaction with each other (Koehler & Mishra, 2008).

Van Olphen (2008), in relation to the TPACK of language teachers, suggested that the foundation of effective integration of technology in language teaching requires the following:

(a) an understanding of how linguistic and cultural concepts can be represented using technology;

(b) educational approaches to language teaching that draw from socio-constructivist philosophies to develop students' language and cultural competence;

(c) an awareness of what facilities or hinders the acquisition of language and the development of language competence and how technology, …, can rewamp common problems that students ordinarily face;

(d) an awareness of students' previous knowledge, and particularly a knowledge of second language acquisition and cognitive development theories;

(e) an understanding of how current and emerging technologies can be used to advance present knowledge and to develop new epistemologies and sustain previous ones (p. 117).

Based on the idea that "teaching successfully with technology requires continually creating, maintaining, and re-establishing a dynamic equilibrium between each component," the TPACK construct used in the present study involved a single component: *using technologies in constructive ways to teach a foreign/second language by considering the needs of the students.*

The results of the qualitative content analysis for the first research question are presented in the *Results of the Qualitative Data* section below.

3.5.3.2. Technology Integration Observation Instrument.

As mentioned above, for the second research question, the lesson plans and observational data of the six cases were analyzed using the Technology Integration Observation Instrument, developed by Harris, Grandgenett, and Hofer (2010), in order to see how PTs' TPACK is reflected in their instructional practices (see Appendix H). Harris, Grandgenett, and Hofer (2010) state the aim of their instrument as assessing "the quality technology integration in an observed lesson." As they mention, the components of the instrument are based on TPK, TCK, and TPACK domains of the TPACK framework. The instrument does not teach TPACK directly but it focuses on "the use of technology integration" in the lesson. This particular instrument was selected for the following purposes: First, it is the only instrument which reflects the key concepts of TPACK. Second, it aims to assess TPACK using the lesson plans of student-teachers, and finally the instrument has proven to be reliable and valid.

In the instrument, there are 6 categories rated using a 4 point-scale each point having specific explanations. The categories are as follows: (1) Curriculum goals and technologies; (2) instructional strategies and technologies; (3) technology selection(s); (4) "fit"; (5) instructional use; and (6) technology logistics (p.3840). Each category receives a score from 1 to 4, with specific explanations. For example, a lesson receiving the rating of 4 for the category of "curriculum goals and technologies" means that "technologies used in the lesson are strongly aligned with one or more curriculum goals" (p. 3840). Harris, Grandgenett, and Hofer (2010) state that the first four categories in the instrument address plans for instruction while the last two categories address the implementation of that plan. Thus, in the present study, the first four categories were used to assess PTs' lesson plans which they prepared to teach at their practice schools. The last two categories were used to evaluate the implementation of those plans during PTs' fieldwork. Each of six PTs was observed by the researcher and their lesson were video recorded for later analysis. The notes taken by the researcher and the video recording were used to determine PTs' technology use according to the instrument.

CHAPTER IV

RESULTS AND DISCUSSION

4.1. Quantitative Data Results

As discussed in the previous chapter, the quantitative data came from the TPACK survey given to the PTs at the beginning and end of the study and SPSS 14 was used for analysis. After the data were entered to the SPSS software, prior to the descriptive analyses, the data were checked for errors. It was seen that there were no missing or out-of-range responses in the data set. Thus, the process of inspecting the data file and exploring the nature of the variables in the data could be started.

In order to answer the research question asking about the changes in technology related knowledge domains, i.e., TK, TCK, TPK, TPACK of pre-service teachers of English who received specifically designed coursework combined with field-experience, Dependent means *t*-test was conducted. The Dependent means *t*-test is a parametric test that is based on the normal distribution; therefore, it is assumed that, first, the sampling is normally distributed. This means that "the sampling distribution of the differences between scores should be normal, not the scores themselves" (Field, 2009, p. 326). Second, data are measured at the interval level.

For the first assumption, in order to describe the characteristics of the data and assess the normality of the distribution scores, mean, mode, median, standard deviation, variance, range and skewness and kurtosis values were obtained for the technology related knowledge domains of the TPACK survey data. The second assumption was fulfilled with the use of Likert Scale which is used as an interval measurement in statistical tests. To say that data are interval, equal intervals on the scale should represent equal differences in the property being measured and the assumption of interval data is tested only by common sense (Field, 2009).

The following table illustrates the descriptive statistics for the variables studied. The table also presents skewness and kurtosis values with their associated standard error which provide information about the distribution of scores for both pre- and post-tests. The values of skewness and kurtosis should be zero in normal distribution. Positive skewness values indicate a pile-up of scores on the left of the distribution while negative values indicate a pile-up on the right. The positive values of kurtosis indicate a pointy and heavy-tailed distribution, whereas kurtosis values below zero indicate a distribution that is flat and light-tailed. “The further the value is from zero, the more likely it is that the data are not normally distributed” (Field, 2009, p. 138).

Table 3

Descriptive statistics

Scale	Test	M*	Mdn	SD	Variance	Range	Skewness	SE	Kurtosis	SE
TK (n= 22)	Pre	3.47	3.43	.69	.47	2.29	-.01	.49	-1.34	.95
	Post	4.29	4.29	.44	.20	1.43	.13	.49	-1.11	.96
TCK (n= 22)	Pre	3.41	3.00	.91	.83	3.00	.30	.49	-.49	.95
	Post	4.64	5.00	.49	.24	1.00	-.61	.49	-1.80	.95
TPK (n= 22)	Pre	3.39	3.30	.66	.44	2.60	-.28	.49	.14	.95
	Post	4.67	4.90	.40	.16	1.20	-.88	.49	-.49	.95
TPACK (n= 22)	Pre	2.82	2.75	.65	.42	2.88	.88	.49	1.71	.95
	Post	3.76	3.69	.37	.14	1.50	.89	.49	1.10	.95

**Mean scores are out of 5.*

For the pre TK scores, the skewness value is very close to zero, indicating a normal distribution. For the rest of the scores, the skewness values indicate positive and negative skewness. Similarly, kurtosis values indicate that the distribution is not normal. Field (2009) suggests that although the skewness and kurtosis values are informative, they can be converted into z-scores which is described as "a score from a distribution that has a mean of 0 and a standard deviation of 1 (p. 138). Converting scores to a z-score is suggested because skew and kurtosis values can be compared against values that can be obtained by chance alone. A value above 2 is considered significantly different from chance to be problematic. Field also adds that for a smaller sample, this criterion should be increased to 2.58. So, an absolute value greater than 1.96 is significant at $p<.05$, above 2.58 is significant at $p<.01$ and absolute values above 3.29 are significant at $p<.001$.

A z-score of any score is obtained by subtracting the mean of the distribution, which is zero in this case, and then dividing by the standard deviation of the distribution (in this case standard error). Skewness is converted to a z-score in this way. For kurtosis, this value's square root is taken. The following are the formulas used as suggested by Field (2009):

$$Z_{skewness} = \frac{S - 0}{SE_{skewness}}$$

$$Z_{kurtosis} = \sqrt{\frac{K - 0}{SE_{kurtosis}}}$$

These two formulas were used to convert the skewness and kurtosis values to a z-score. The following table shows the converted values for each variable.

Table 4

Z-scores

Scale	Test	Zskewness	Zkurtosis
TK (n= 22)	Pre	.01	1.19
	Post	.26	1.08
TCK (n= 22)	Pre	.60	.72
	Post	1.24	1.38
TPK (n= 22)	Pre	.57	.38
	Post	1.79	.72
TPCK (n= 22)	Pre	1.78	1.34
	Post	1.81	1.08

The z-scores of skewness and kurtosis reveal that there is no significant positive or negative skewness or kurtosis for the variables of the TPACK survey, i.e., all scores are below 1.96, the lower threshold.

However, as the skewness values of the TPK post, TPACK pre- and post-tests were large, data were checked for outliers. Outliers have deleterious effects on statistical analysis and they may increase error variance, reduce the power of statistical tests and decrease normality (Osborne & Overbay, 2004). In order to understand how much of a problem those detected outlying cases are likely to be, descriptive tables were checked for the 5% trimmed mean. If the original mean and the trimmed mean is compared, the influence of the outliers on the mean can be understood (Pallant, 2001). If the two values are very different, the outlier(s) can be removed from the data. In this study, as the trimmed mean and original mean scores were very close for the variables studied and as the sample size was small (N= 22), no data were removed from the data file.

Following the descriptive analysis, Dependent means t-test was applied to the data coming from the technology related knowledge domains of the TPACK survey in order to understand whether PTs' technology related knowledge increased after participating into the present study. For the pre- and post-test differences in each sub-scale, *t*-statistics, *p*-values and eta squared measures were calculated. Table 5 presents the t-test findings for the four subscales.

Table 5

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			
TPCK (n= 22)	Pre	2.82	.65	.14	-9.41	21	.000
	Post	3.76	.37	.08			

***** *p<.001*

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. Pallant (2001) states that there is more to research than just obtaining statistical significance because the probability values obtained from t-tests do not tell about the magnitude of the intervention's effect. She suggests calculating the effect size statistic which "indicates the relative magnitude of the differences between means" (p. 175).

In order to calculate the strength of association, eta squared which is one of the most common effect size statistics and which "represents the proportion of variance of the dependent variable that is explained by the independent variable" (p. 175) was obtained. Values for eta squared ranges from 0 to 1 and the guidelines suggested by Cohen (1988) can be used for its interpretation. Cohen suggests that .01= small effect, .06= moderate effect and .14= large effect.

The following formula was used to obtain eta squared for the variables studied in the present study and Cohen's guidelines were followed for their interpretation.

$$\text{Eta squared} = \frac{t^2}{t^2 + N - 1}$$

The eta squared value found 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 intervention.

To conclude, the quantitative phase of the present study showed that the coursework that was specifically designed to develop TPACK and that was combined with fieldwork developed PTs' technology related knowledge domains, i.e., TK, TCK, TPK, and TPACK significantly.

4.2. Qualitative Data Results

The process of analyzing the qualitative data was described in the previous chapter. This section presents the qualitative results in relation to the first question investigating the change occurring in the TPACK of Turkish pre-service teachers of English and second research question focusing on how PTs' TPACK is reflected in their instructional practices.

As discussed in the previous section, the data were organized and analyzed in a chronological order as follows:

Before the treatment

- written reflections on the given case (reflection 1)
- written reflections on the first lesson plan they prepared on a topic and grade level of their choice (reflection 2)

During the treatment

- written reflections on the first version of the lesson plan they prepared to be taught in their practicum school (reflection 3)
- written reflections on the feedback they received from the instructor and their peers on their lesson plans (reflection 4)
- written reflections on their micro-teaching at their practicum schools (reflection 5)
- audio recordings related to their micro-teaching (interview before and after micro-teaching)

After the treatment

- written reflections of PTs on the same case given before the treatment (reflection 6)
- written reflections on the first lesson plan PTs prepared on a topic and level of their choice before the treatment (reflection 7).
- overall evaluation of the study they participated in (reflection 8).

It was discussed in the Methodology chapter above that six PTs were selected for the in-depth analysis of the first research question and for the second research question based on their TPACK scores coming from the TPACK questionnaire. Those cases were selected from

each level, i.e., low, medium and high- two from each. The findings of the qualitative data are presented for each of six pre-service teachers separately as follows:

For the in-depth analysis of the first research question, first, a brief profile of each case with the percentage of coded segments over the time periods classified as before, during and after the treatment for each of the seven categories, i.e., CK, PK, TK, PCK, TCK, TPK and TPACK, is presented. Second, a figure representing the changes in the technology related components of the TPACK (i.e., TK, TCK, TPK and TPACK) is displayed. Third, findings are discussed in detail and supported by quotations from the data.

For the second research questions, an overview of each case's lesson plan is provided and the analysis of their lesson plan and its implementation according the Technology Integration Observation Instrument is presented.

Finally, a summary of the findings for each case is presented.

4.2.1. Case 1: Pınar.

According to the findings of the TPACK questionnaire, Pınar had a low level of TPACK. Her placement school was a state Anatolian high school. She attended a 9^{th} grade class for her practicum.

Research Question 1: The following table of means (Table 6) and the graph of reflections (Figure 9) show the percentages of her coded data for the seven categories and offer insights into the change in her knowledge bases.

Table 6

Percentage of data segments assigned to each coding category for Pınar

		CK	PK	TK	PCK	TCK	TPK	TPACK
Before	Reflection 1	0.0	100	0.0	0.0	0.0	0.0	0.0
	Reflection 2	0.0	46.1	7.6	17.8	20.1	0.0	0.0
		0.0	**73.1**	**3.8**	**8.9**	**10**	**0.0**	**0.0**
During	Reflection 3	6.2	22.7	0.0	28.5	0.0	33.1	5
	Reflection 4	21.7	5.7	0.0	18.6	1.9	6.6	5.5
	Reflection 5	0.0	22.6	0.0	25.7	0.0	0.0	25.5
	Interview 1	0.0	0.0	0.0	27.8	0.0	0.0	49.7
	Interview 2	0.0	0.0	0.0	25.6	0.0	18.3	42.7
		5.6	**10.2**	**0.0**	**25.2**	**0.4**	**11.6**	**25.7**
After	Reflection 6	0.0	0.0	0.0	0.0	0.0	0.0	100
	Reflection 7	0.0	5.9	0.0	21.6	0.0	0.0	68.6
	Reflection 8	0.0	0.0	7.1	0.0	0.0	2.9	58.8
		0.0	**2**	**2.4**	**7.2**	**0.0**	**1**	**75.8**

Note. The rows do not total 100% because all coding categories are not presented here.

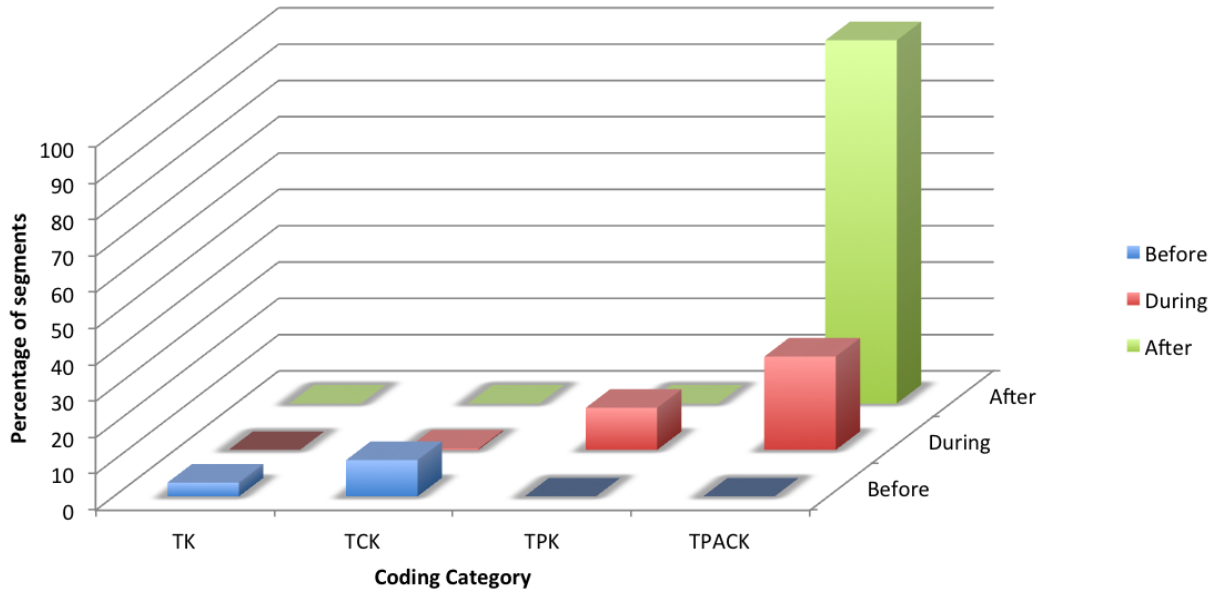

Figure 9. The changes in the technology related knowledge components of TPACK for Pınar

The representation of the data segment percentages for Pınar shows that there were changes in the focus of her reflections as the study progressed. At the beginning of the study, Pınar's reflections showed her knowledge of pedagogy (73.1%), technology (3.8%), pedagogy and technology (8.9%) and technology and content (10%) while none of her comments reflected her CK, TPK or TPACK. As the study progressed, the most significant changes were observed in Pınar's PK and TPACK. While her PK decreased sharply (from 73.1% to 10.2%), her comments reflected her increased understanding of TPACK (25.7%). At the end of the study, Pınar's comments reflecting the isolated knowledge components (CK, PK and TK) and their combinations (TCK, TPK and PCK) dropped in number while her comments were dominated by TPACK (75.8%).

These changes are discussed in detail for Pınar below.

Before the treatment

When her early reflections, collected before the treatment, are analyzed, it can be seen that the majority of her comments reflected her PK (73.1 %). In these early reflections, she focused on pedagogy, mostly in isolation and in relation to content (PCK, 8.9 %). Her technology related comments were very limited. For instance, T (taken singly) is 3.8 % and with content (TCK) is 10 %. None of her comments reflected her knowledge of technology in combination with pedagogy (TPK) or pedagogy and content (TPACK).

The following quotations demonstrate her knowledge bases before the treatment:

> I considered the age and interests of the students when I was planning the lesson. I also considered the facilities in the classroom and the materials available. Finally, I kept in mind the capacities of the students: what they can do and what they cannot do *(PK-Reflection 2).*

During the implementation of my plan, students may need help while talking about the topic. They may not know the relevant vocabulary or can lack some grammatical structures. I will provide them with the necessary vocabulary and structure when needed *(PCK- Reflection 2).*

I am competent at using technologies such as video and e-mail. I can download and upload videos and use e-mail for many purposes. I am sure my students can use them, too *(TK- Reflection 2).*

For their column, they need to do some research about the environmental problem they choose. They need some factual and statistical information. Thus, they will use the Internet *(TCK- Reflection 2).*

During the treatment

When Pınar's data collected during the treatment is analyzed, some changes in the patterns of her reflections are observed. During the treatment, there was little talk about content and pedagogy in isolation (5.6 % and 10.2 % respectively). In terms of PK, a dramatic decrease was observed (from 70 % to 10.2 %) compared to the earlier data. Pınar's comments showed that she began to consider pedagogy in relation to content (PCK, 25.2 %) and technology (TPK, 11.6) and content and technology together (TPACK, 25.7 %).

The most significant changes could be observed in her technology related knowledge. While her earlier data (before the treatment) showed little instances of technology related knowledge, the data collected during the treatment showed that there was a dramatic increase especially in her TPACK. While in the early data none of her comments focused on the relationship among content, pedagogy and technology, during the treatment her reflections

and talk showed its instances at a high percentage (TPACK, 25.7 %). The following quotations provide evidence for the knowledge bases of Pınar during the treatment:

> The content I focus is on cross curricular, real life content. The topic is about natural disasters. The outcomes and effects of a volcanic eruption are discussed throughout the text *(CK- Reflection 3).*

> I considered the abilities of my students while planning my lesson. I often asked myself this question: What should I do so that they can learn better? I thought about the context and the environment. The seating arrangement, for example, constrains us while doing group work so I decided to change it. I will turn it into buzz groups *(PK- Reflection 3).*

> The text in the coursebook is not familiar to the students in terms of its topic. It is about a natural phenomenon that we do not experience in Turkey, thus they need help to understand the content. If they do not understand it, they cannot carry out the tasks *(PCK- Reflection 3).*

> I smoothly combined the technology with my content. The video I have chosen will not be watched for the sake of watching it. It has a much better and clear purpose now. The main focus is on content not on the technology. In my plan the technologies are only means to achieve certain goals. It will activate and form students' background knowledge on the topic of the reading in the coursebook *(TCK- Interview before teaching).*

> While choosing the technologies to use in my lesson, I considered the context. I would not use a podcast, for example, since we do not have internet connection at the school. Viki, for example, would not match my objectives. The affordances and constraints of the tools I would use also affected my decisions. Video, for example, is something that will expose my students to the information they need to fill the gaps in their schemata. They should deduce information that they do not know from the video and add it to their already existing knowledge. For this purpose, I cannot choose Facebook or e-mail *(TPK- Reflection 3).*

> Throughout the planning process, these sentences echoed constantly in my head: Start with the problem; Technology should be transparent; Do not use technology for the sake of using it; How can I maximize students' learning? ; Do not be techno-centric; think about the affordances and constraints. Then I chose the technological tools I would use, the pedagogy to match it and did some changes in the content so that they all support each other: content, pedagogy and technology *(TPACK- Interview before teaching).*

After the treatment

The latest data collected after the treatment showed dramatic changes in the pattern of TPACK. Compared to her initial reflections, Pınar's TPACK could be observed in the majority of her reflections at the end of the study (75.8 %). This ratio was 0% before the study and 25.7 % during the study.

Another observation was the decreasing ratios of isolated knowledge bases: CK, PK and TK (0 %, 2 %, and 2.4 %, respectively). As the study progressed, Pınar began to consider

these knowledge bases in relation to the others demonstrating her understanding of the relationships between and among them.

The following comments of Pınar show her focus at the end of the study:

I would never use this plan as it is. The lesson flow is very ineffective and needs some changes. For the reading, there must be skimming, scanning and comprehension check activities. Plus, the post reading activity should be more creative *(PK- Reflection 7).*

Before the project, I was not a very technology-friendly student. To be honest, I was rather scared of using technology. For me, technology meant using word processor and power point programs, and checking my e-mails. Downloading or sharing a video, recording a voice always made me anxious. If I were supposed to download a video for one of my projects, I would feel panicked. I would always ask for help from more technology-friendly friends of mine. Moreover, I did not know much about educational technologies. This training taught me a number of new technologies, and raised my confidence in using them. Now I am a very technology friendly person *(TK-Reflection 8).*

If I could rewrite my plan, I would find a reading passage from a coursebook rather than writing a text myself. In my plan, students read a passage about environmental problems and match the pictures with the environmental problems given. However, there are no skimming or scanning activities and comprehension questions. If they are going to do some reading, these activities are must. The post reading activity I used is not creative at all *(PCK- Reflection 7).*

> During my lesson, the students did not focus on my or their use of technology. In other words, their attention was not distracted by the use of technology. Technology is not an aim. It is a tool which helps us achieve our goals. While integrating technology, I have one question in my mind: why? If I have got a satisfactory answer, then I decide to use it in my plan *(TPK- Reflection 8).*
>
> In the case, the teacher does not use technology for the sake of using it. Her starting point is not technology use. There was a problem that required a solution and she solved it using technology. Bearing the problem, the students, and the context in mind, she found online portfolio application useful and applied it. She wanted to improve students' writing ability and solve classroom management related problems. She combined technology, content and pedagogy. As there is a computer lab in the school, she did not experience any problems. In fact her technology use was rather transparent. In the end it was seen that the integration was rather useful as the quality and length of writing improved and classroom management problems were solved. We can see all the elements of TPACK within this case as well as transparent technology use, creativity, sharing, etc. It summarizes what we should do as teachers *(TPACK- Reflection 6).*

Research Question 2. In order to answer the second research question for Pınar, the lesson plan she prepared for her practicum was analyzed in detail and her lesson was observed using the Technology Integration Observation Instrument (Harris, Grangenett & Hofer, 2010). Pınar was assigned a coursebook unit to teach in her practice school. The unit was about Natural Disasters and it was based on a reading text about the outcomes of the possible eruption of the volcano on Canary Islands. The class she participated at her practice school

consisted of 26 students, though on her teaching day only 16 of them were present in the lesson. In the classroom available technologies were a CD player and a projector. There was no computer or Internet connection. Teachers brought their own laptops to the lessons.

Pınar stated her lesson goal as follows: "Students will be able to understand a written text about a natural disaster and they will be able to talk about a disaster and its outcomes by using the related words and structures." During the lesson, the digital technologies Pınar used were a video, projector, laptop, and camera.

The first category of the instrument focused on the match between technology and curriculum in the lesson plan. As mentioned above, Pınar wanted her students to be able to comprehend a text about natural disasters and talk about their outcomes by using relevant vocabulary and structure. In her plan she uses a video as a pre-reading activity to build background knowledge of the students on volcanic eruptions. Her stated aim is to familiarize students with the topic as volcanic eruptions are not experienced in Turkey. For the speaking part of her goal, Pınar planned to ask students to prepare a short video in which they report an imaginary eruption in which they describe and warn the people. Considering these, it can be said that Pınar's lesson plan receives 4 (technologies used in the lesson are strongly aligned with one or more curriculum goals) as she uses the technologies effectively to achieve her goals during the lesson.

The second category of the instrument was about the match between instructional strategies and technologies. Pınar's lesson plan was based on Task Based Language Teaching. Students would work in groups to carry out a communicative task in which they use English for some real purposes. In other words, the instructional strategies she chose were based on the active participation of the students. Asking students to record a video in which they report the outcomes of an imaginary volcanic eruption supports her pedagogy as she wants the students to work in groups and be active users of the language. Considering these, Pınar's

score in the second category can be 4, i.e., technology use optimally supports instructional strategies.

The third category referred to the technology selection(s) of the teacher. In other words, it focused on matching technology to both curriculum and instructional strategies. Considering the content of the lesson and the pedagogy Pınar planned to use in her lesson, technology selections of her can be considered as exemplary (receiving 4). Her aim of using a video at the beginning of the lesson was to build background knowledge of the students. She used the technology herself as she was informing the students about the topic. Pınar stated in her lesson plan that students would create their own videos in groups and talk about an eruption. Thus, the technologies she chose were very appropriate for the content and pedagogy she planned for her lesson.

The fourth category was about the "fit" among the three knowledge components: content, pedagogy and technology. As explained above, the content Pınar planned to teach, the pedagogy she chose for her lesson and the technologies she included in her plan were all in harmony, supported each other and resulted in a complete and effective lesson plan (4, curriculum, instructional strategies and technology fit together strongly within the lesson).

The observed lesson of Pınar was evaluated according to the final two categories of the instrument. During her lesson, Pınar's instructional use of technology was maximally effective. In other words, she integrated the technologies she used into the lesson effectively. When she used the video at the beginning of the lesson, as a pre-reading activity, she seemed in control. She introduced the video and gave students a reason to watch it. Students were supposed to watch it and note down some factual information presented in the video. After introducing the task, near to the end of the lesson, she described, in detail, how students should prepare their 2-minute-videos. She explicitly instructed them to include the following in their videos:

a. When is the volcano going to erupt?
b. What are the facts?
c. What is going to happen?
d. What are the consequences?
e. A message about the eruption such as "BE AWARE!"

In the classroom, students began to write the text of their video in groups. If they had not had time to engage in recording (using their mobile phones) during the class hour, they could do their recording outside the class and bring it to the next lesson. Considering these, it can be concluded that her instructional use of technology receives 4, i.e., "instructional use of technologies is maximally effective in the observed lesson."

The final category in the instrument was about operating technologies effectively. When the teacher used the technology herself, she was very confident and had no problems. Some students in the class began recording themselves for the task using their mobile phones. They were observed not to have any problems technically. Thus, both the teacher and the students operated technologies very well in the observed lesson (receiving 4).

Summary of case 1*:* Based on her responses to the TPACK questionnaire, Pınar was found to have a low level TPACK. This finding was supported with the qualitative data collected at the beginning of the study, before the treatment began. Pınar's reflections revealed that most of her comments were not focused on technology. In her reflections, she basically focused on pedagogy (73.1 %). None of her comments reflected that she considered technology in relation to content and pedagogy (TPACK, 0 %). However, as the study progressed and she was exposed to the treatment, there was a change in the focus of her reflections. A dramatic increase was observed in her TPACK (25.7 % during the treatment and 75.8 % after the treatment). In other words, she apparently began to consider technology,

content and pedagogy together. This was also evident in the lesson plan she prepared for her practicum and its implementation. Both during the planning and implementation processes Pınar reflected her developed TPACK.

Fieldnotes from her teaching supported all these findings. Her lesson at the practice school was effective and she demonstrated how effectively she could integrate technology into her lessons and improve the quality and teaching and learning. At the end of the study, she became more confident of her technology integration skills. During her lesson, she looked confident most of the time though she was very excited before her lesson began. Just before the lesson she said she felt herself very competent and she had changed a lot. She could solve her problems herself now. Before, she always sought help from her peers when she had to do something with technology. In this study, she learned how to learn. She could use a number of technologies. She added that her friends call her "Ms Technology." She looked very enthusiastic. Her enthusiasm was reflected into her teaching and it affected the motivation and participation of her students positively.

4.2.2. Case 2: Gözde

Gözde was the second case who had a low level of TPACK according to the findings of the TPACK questionnaire. She completed her practicum at a state Anatolian high school. The class she participated in for the practicum throughout the year was a 9th grade class with 32 students.

Research Question 1. In the following table, the percentages of her coded data for the seven categories can be observed.

Table 7

Percentage of data segments assigned to each coding category for Gözde

		CK	PK	TK	PCK	TCK	TPK	TPACK
Before	Reflection 1	0.0	100	0.0	0.0	0.0	0.0	0.0
	Reflection 2	0.0	25.9	16.5	57.6	0.0	0.0	0.0
		0.0	**63**	**8.25**	**28.8**	**0.0**	**0.0**	**0.0**
During	Reflection 3	0.0	34	0.0	7.1	30.9	17.6	0.0
	Reflection 4	0.0	0.0	0.0	12.8	29.7	15	24
	Reflection 5	0.0	23.4	0.0	32.6	0.0	23.8	0.0
	Interview 1	0.0	0.0	0.0	24.5	0.0	0.0	50.9
	Interview 2	0.0	0.0	0.0	27.3	0.0	12.6	43.7
		0.0	**11.5**	**0.0**	**20.9**	**12.1**	**13.8**	**23.7**
After	Reflection 6	0.0	0.0	0.0	0.0	0.0	0.0	100
	Reflection 7	0.0	0.0	0.0	0.0	0.0	0.0	77.1
	Reflection 8	0.0	0.0	13.5	0.0	0.0	26.6	33.8
		0.0	**0.0**	**4.5**	**0.0**	**0.0**	**8.9**	**70.3**

Note. The rows do not total 100% because all coding categories are not presented here.

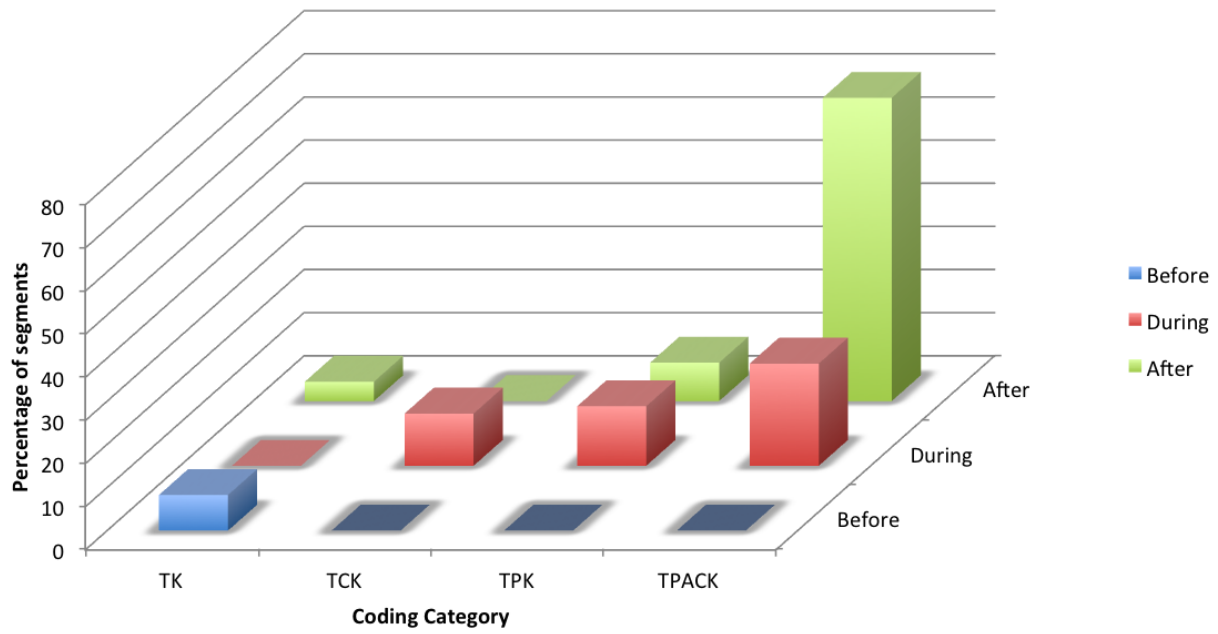

Figure 10. The changes in the technology related knowledge components of TPACK for Gözde

The table of means and the Figure 10 above offer insights into the overall patterns of reflection for Gözde. At the beginning of the study, her comments were mostly dominated by pedagogy (63%) and pedagogy and content (28.8%). None of her comments reflected her CK, TCK, TPK or TPACK. As the study progressed and PTs were exposed to the treatment, Gözde began to consider content, pedagogy and technology in relation to each other (TPACK, 23.7%). At the end of the study, there was a profound change in the focus of Gözde's reflections. The majority of her comments were categorized as TPACK (70.3%) while the other knowledge components were reflected in her comments to a very small extent (TK, 4.5% and TPK, 8.9%) or not at all (CK, PK, PCK, and TCK). The details are discussed below.

Before the treatment

As can be observed from the percentages, before the treatment, Gözde's comments reflected that she mostly treated pedagogy and technology in isolation (PK, 63 % and TK, 8.3 %) though the comments reflecting her TK was very limited in amount. Only 28.8 % of her comments showed that she considered pedagogy and content together. None of her comments focused on the combination of technology with content or pedagogy (0 % for TCK, TPK, and TPACK). The following quotations demonstrate Gözde's knowledge bases before the treatment began in the study:

> I find the solution of the teacher creative in this case. The teacher does not only encourage students to improve their writing but also encourages them to take responsibility of their own learning. I think this solution matches the needs of the learners and students concentrate on the lesson better *(PK- Reflection 1).*

If I were to implement the plan I prepared with technology in a real classroom, I would have some problems. I am not used to teach with technology and I am not very good at technology in general. My technology skills are very limited *(TK- Reflection 2).*

In one of the ELT conferences I attended, I learned how commercial ads can be used to teach grammar. I think this is a very good idea. Students would find it interesting and attractive. That's why I decided to use them in my plan to teach predictions *(PCK- Reflection 2).*

During the treatment

When Gözde's reflections that were collected during the treatment were analyzed, some changes were observed in the patterns of her focus. The two important changes occurred for PK and technology related knowledge bases. Her PK dropped from 63 % to 11.5 %. She began to treat pedagogy in relation to content, technology and content and technology. Before the treatment while her TCK, TPK and TPACK was not evident in her comments, during the treatment she demonstrated her technology knowledge in combination with the other knowledge bases (TCK, 12.1 %; TPK, 13.8 %; and TPACK 23.7 %).

Here are the quotations demonstrating her knowledge bases during the treatment:

While planning my lesson, I tried to integrate more group and pair work activities instead of just lecturing. I wanted my lesson to be more student-centred than teacher-centred. I considered the students' multiple intelligences too *(PK- Reflection 3).*

In my lesson, I am planning to give my learners a handout with some cues. They will use the cues and write a short dialogue about offering a help to a friend about some computer problems by using the question tags. This way, their learning will be

facilitated and they will be practising the question tags in context *(PCK- Reflection 3).*

After the feedback session, I decided to use a podcast in my lesson. I think podcasts are very beneficial to improve students' pronunciation skills. Generally, students do not have the opportunity to listen to themselves to realize their pronunciation problems. By recording their speech and letting them to listen to themselves, I will make them realize how the intonation of question tags change the meaning of the sentences *(TCK- Reflection 4).*

Recording their voices, listening to themselves, reflecting on their pronunciation and intonation actively involved my students into the lesson. They felt responsible for their own learning *(TPK- Interview after teaching).*

After the feedback sessions, I clearly understood that we should make technology absolutely transparent while we are using technological devices in our lessons. I can say that I learned how to think, what I should concern, which points are significant while planning a lesson that integrates technological devices. I saw in my teaching that only if I consider the relationship among technology, content and pedagogy, I will have effective lessons. The technology I chose matched my content and I changed my pedagogy to match both content and technology *(TPACK- Reflection 4).*

After the treatment

At the end of the study, it was observed that TPACK increased dramatically in Gözde's comments (0 % at the beginning, 23.7 % during the middle, and 70.3 % at the end). In other words, she began to consider technology, content and pedagogy jointly after

receiving the treatment. Her comments focusing on the knowledge bases in isolation decreased and ceased.

The following are the comments illustrating these points:

> I learned a lot of new things about technology during the study. At the beginning, I was not confident about using technology. My technology ability was limited to the use of few technologies. But now I know a number of new technologies and I can use them in my teaching very confidently and productively *(TK- Reflection 8).*

> At the beginning, I had questions in my mind about using technology in the classroom. After the training and the feedback sessions, now I see that technology could be used in various ways and if used effectively, it changes the way we teach and the way students learn *(TPK- Reflection 8).*

> In this case, by using online portfolios, the teacher does not only solve the classroom management problems but also improves students' writing skills. From this case, I clearly understand that we should not always try to integrate technological tools because they are just interesting and we like them. We should have a clear purpose in mind. We should consider whether it is appropriate to what we are teaching, whether it meets our students' needs, whether it offers a solution to our problems and whether it helps us to achieve our teaching goal or not *(TPACK- Reflection 6).*

Research Question 2. For the lesson at her practice school, Gözde used the coursebook *Upstream A2* for the 9th grade students at her practicum school. She planned her lesson for the unit called "Click on it" which focused on computer parts. The unit began with matching the pictures with computer parts. Students were asked to complete the given

paragraph with those words. Then, students were asked to tick the ways they used computers and talk about it. Listening and Reading section followed. Students listened and repeated the given sentences from the dialogue following. Then, they read the dialogue in pairs. The grammar topic of the unit was Question Tags. Students were asked to listen to some questions and find out the rules of question tags. Then came its practice in which they decided if the question tags used in the questions they listened to meant "sure" or "not sure".

In the classroom in which she did her practicum teaching, there were 23 pre-intermediate level students. The classroom had a traditional seating arrangement. In the classroom, there was only a projector and audio-tape. As her objectives, Gözde stated the following:

- Students will be able to identify the basic parts of a computer.
- They will learn how question tags change the meaning of sentences.

Gözde's materials were the coursebook, a microphone, a laptop and speakers.

In order to understand the extent to which her technology use and curriculum goals match, for the first category, Gözde's lesson plan was analyzed. In the plan, she had two main goals: developing students' computer related vocabulary and teaching them the intonation of question tags. For the second goal, Gözde used the CD of the coursebook and podcasting. In the plan, students were, first, supposed to listen to the CD and hear different intonation of question tags. The stated aim was to help students understand how the intonation of question tags changes the meaning of the sentences. Following that, students would create their own dialogues using the prompts given and be asked to use question tags in their dialogues. When their dialogues were ready, they would record their dialogues and create their podcasts. Then students would post their podcasts to a podcast hosting page created by their teacher. Students would be encouraged to listen to each other's dialogues and comment on them. In the following lesson, the teacher would use the recording of the students and take their attention

to the intonation of question tags. Looking at this plan, it can be concluded that technologies used in Gözde's lesson are "strongly aligned" with one or more curriculum goals receiving 4 out of 4.

In her lesson plan, Gözde stated that she would use a student-centred pedagogy. She wanted the students to be active when they created dialogues in groups, listened to themselves and their friends' podcasts, and commented on them by referring to the intonation of question tags. Students would create their dialogues in the classroom and upload them to the classroom podcast page after the lesson. To help students upload their podcasts to the page, she planned to prepare a handout describing how to create and upload a podcast. Thus, it can be said that, although in the early stages of her plan Gözde adopts a teacher-centred pedagogy and teaches students the question tags, she changes her pedagogy from being teacher-centred to student-centred as the creation of a podcast requires it. She would, then, receive 4, for the second category of the instrument, which means "technology use optimally supports instructional strategies."

For the third category, "technology selection(s)" referring to the "matching technology to both curriculum and instructional strategies," it can be said that that Gözde's technology selections were "exemplary, given curriculum goal(s) and instructional strategies," thus receiving 4. As discussed above, the use of podcasting matched her aim of improving students' intonation of question tags and enabled students to work independently and take responsibility of their own learning.

In terms of the "fit" of curriculum, pedagogy and technology all together, Gözde's lesson plan can receive the score of 4, which means "curriculum instructional strategies and technology fit together strongly within the lesson." When her lesson plan was analyzed, the fit among the three components; curriculum, technology and pedagogy, could be observed. As discussed above, using podcasting to improve students' pronunciation skills was a good

choice. Asking students to create their own podcasts made them active. Thus, technology, pedagogy, and content all supported each other, which would improve the quality of teaching.

For the implementation process, it can be said that Gözde's instructional use of technologies was effective in her observed lesson (receiving 3). When she used the CD of the classroom, she explained to the students, in detail, what they were supposed to pay attention while listening to the CD. So, her integration of CD into the flow of the lesson was smooth. When she introduced the task of creating a dialogue and recording it, she however emphasized the technology. At the beginning, students could not understand why they were supposed to create a recording. After explaining the process of task, Gözde mentioned why they were supposed to record their dialogues. Then, students' confusion ended and they focused on their task.

The final category referred to teachers' and/or students' operating technologies. In the observed lesson of Gözde, she operated technologies well (receiving 3). There was no problem in using the CD. However, when she wanted to show how students could create their podcasts and upload them on the podcasting page, she had some difficulties. She was confused too about how to use them. But later she could describe the process step by step. About the technology use of the students, it can be said that they were very good at creating a podcast. When some of the groups in the classroom completed writing their dialogues, they began recording themselves to their mobile phones. It was apparent that they were already skilled at recording themselves. Thus their technology use in the lesson can be considered as very proficient (receiving 4).

Summary of case 2: It can be concluded for Gözde that, as evidenced by the findings of the TPACK questionnaire and qualitative content analysis, she did not consider technology in relation to content and pedagogy at the beginning of the study. Most of her comments

revealed that, at the beginning of the study, she was not confident about her technology skills in general and about integration of technology into language teaching process. However, as she received the treatment, very significant changes were observed in her comments in terms of the patterns of communication. Her comments revealed that she began to match technology, content and pedagogy to each other (0 % at the beginning, 23.7 % during, and 70.3 % at the end). These findings were triangulated with the data coming from her lesson plan and the field notes of the researcher taken during its implementation. The plan she prepared during the treatment showed that she used technology effectively to improve the quality of her lesson. She gave reasons about her choice of technologies in relation to what she was teaching and how. She was far from being techno centric during most of the lesson and she tried to make her technology use as transparent as possible to make technology integration natural. She was observed to have some problems but she explained it as resulting from her inexperience of integrating technology into her teaching both in theory and practice. After the lesson, she said she was aware of her excitement when she introduced the technology. She added that she had a lot of worries when she decided to participate into the study. She was not sure if she could offer a successful contribution to the study. She said she was now feeling different. She was now confident about her ability to integrate technology into her teaching. As she explained, the problem during the lesson was her lack of experience.

4.2.3. Case 3: Zeynep.

Zeynep's TPACK level was found to be medium according to the results of the TPACK questionnaire. She completed her practicum at a private primary school. The class she attended was a 4th grade class with 18 students. The coursebook studied was *Incredible English 4* (Redpath, Morgan & Phillpis, 2007).

Research Question 1. The percentages of her coded data can be seen in Table 8. The Figure 11 following the table indicates the changes that occurred throughout the study.

Table 8

Percentage of data segments assigned to each coding category for Zeynep

		CK	PK	TK	PCK	TCK	TPK	TPACK
Before	Reflection 1	0.0	28.3	0.0	0.0	16.6	55.1	0.0
	Reflection 2	0.0	52.9	0.0	0.0	0.0	47.1	0.0
		0.0	**40.6**	**0.0**	**0.0**	**8.3**	**51.1**	**0.0**
During	Reflection 3	0.0	17.6	0.0	54.8	9.6	18	0.0
	Reflection 4	0.0	0.0	0.0	31.8	25.4	0.0	0.0
	Reflection 5	0.0	79.6	0.0	11.5	0.0	8.9	0.0
	Interview 1	0.0	14.6	0.0	22.8	0.0	26.4	24
	Interview 2	0.0	22.6	0.0	26.6	0.0	17.5	13.4
		0.0	**30.3**	**0.0**	**29.5**	**7**	**14.2**	**7.5**
After	Reflection 6	0.0	0.0	0.0	0.0	23.7	53.8	22.5
	Reflection 7	0.0	0.0	0.0	0.0	9.3	64.9	25.8
	Reflection 8	0.0	19.2	0.0	0.0	0.0	0.0	7.3
		0.0	**6.4**	**0.0**	**0.0**	**11**	**39.6**	**18.5**

Note. The rows do not total 100% because all coding categories are not presented here.

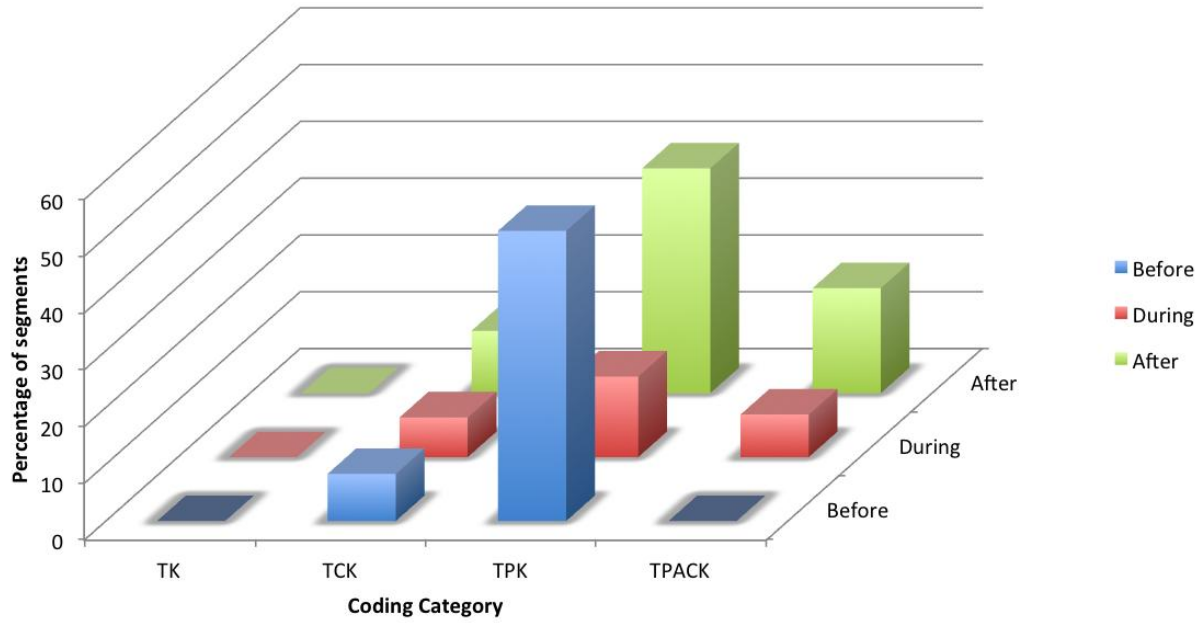

Figure 11. The changes in the technology related knowledge components of TPACK for Zeynep

The analysis of Zeynep's data showed that pedagogy was the dominating topic in her comments in isolation (PK, 40.6%) and in relation to technology (TPK, 51.1%) at the beginning of the study. As she was exposed to the treatment, pedagogy continued to be her focus in her reflections and interviews (PK, 30.3%, PCK, 29.5%, and TPK, 14.2%). She also began to understand the relationship between pedagogy, content and technology (TPACK, 7.5%). There were some changes in the focus of Zenep's reflections as the study ended. The majority of her comments were related to technological issues (TCK, 11%, TPK, 39.6%, and TPACK, 18.5%). The details of Zeynep's data are discussed below.

Before the treatment

Zeynep's comments prior to the study showed that she mostly focused on PK and TPK (40.6 % and 51.1 %, respectively). While she considered pedagogy in isolation, she discussed technology in relation to pedagogy. Only 8.3 % of her comments revealed her TCK. None of

her comments focused on technology in isolation or technology in relation to content and pedagogy. Here are the comments showing her PK, TCK and TPK before the treatment began:

> I like the solution of the teacher, but this solution might be a problem for shy and unconfident students. They might not like sharing their writings with their peers with the fear of being scolded because of their mistakes (PK- *Reflection 1*).

> The use of online portfolios improves students' writing ability as the audience is not now only the teacher. As students know that their friends will read their writings too, they are more careful and motivated about their writing *(TCK- Reflection 1).*

> In today's world, most of the students have computer and Internet skills, thus I found the choice of an online portfolio very logical. Its use would attract and get students' attention. Students would spend more time on computers to write, share and rewrite *(TPK, Reflection 1).*

During the treatment

During the treatment, some changes were observed in Zeynep's PK, TK, TPK and TPACK. While there was a decrease in the instances of PK (from 40.6 % to 30.3 %) in her comments, there was a significant increase in her PCK (from 0 % to 29.5 %). In other words, she began to discuss pedagogy in relation to content. Another change occurred for TPACK. While none of Zeynep's comments reflected her TPACK at the beginning of the study, this percentage increased to 7.5 % during the treatment. The following comments illustrate her knowledge bases during the treatment:

I do not think that my lesson went as well as I had planned. My activities were very good but unfortunately my excitement of doing a macro teaching for the first time resulted in some confusing instructions. I also could not answer some of the questions coming from the students and could not remember some steps during the lesson *(PK- Interview after teaching).*

The unit that I use for my lesson plan is about aquatic life animals which most students are probably not familiar with. Thus, they might have difficulty in understanding the topic because of lacking background knowledge on it. This is a problem for the flow of the lesson. I might not achieve my objectives if I do not form students' background knowledge on the topic *(PCK- Reflection 3).*

During the lesson, I will teach different kind of fish names to my students. To make them familiar with the fish, I planned to use Wikipedia. Students would use it to learn about these fish and their features *(TCK- Interview before teaching).*

I chose Wikipedia because it offers information to its users on nearly every topic. You can find information about the aquatic fish and see their pictures too. I think my students would like to read about fish and see their pictures *(TPK- Interview before teaching).*

After the treatment

At the end of the project, Zeynep's comments showed that she began to relate technology to pedagogy, to content and to content and pedagogy together (TPK, 39.6 %, TCK, 11 %, and TPACK, 18.5 %). The only knowledge base in isolation was PK though it

had a very low percentage (6.4 %) compared to its percentage at the beginning (40.6 %) and during (30.3 %) the study. The following quotations illustrate Zeynep's focus in her reflections:

> When I listened to the feedback given to my and my friends' lesson plans, I learned how to think while preparing a lesson plan. I know the steps to be followed now and can prepare more effective and consistent plans *(PK- Reflection 8).*

> If we plan to use technology in our lessons, we should first find out the possible problems in content: which parts would be difficult for them? Then we should decide the tool to solve this problem *(TCK- Reflection 8).*

> Technology use in the classroom attracts today's students as they are already good users of several technological tools. Thus, online portfolio use in the given case is good choice to motivate the students. Besides, using online portfolio with students makes sharing, revising and giving feedback possible. It does not limit learning to the class hours *(TPK- Reflection 8).*

> Technological tools attract students' attention but in order to use them in the classroom you should have other reasons. If I were asked to revise my initial plan, I would choose a technological tool by considering what I can do with it. That technology should help me teach my topic in a more effective way and involve students into the lesson *(TPACK, Reflection 7).*

Research Question 2. For the second research question, Zeynep's lesson plan was analyzed and her lesson at the practicum school was observed. Zeynep did her practicum at a private primary school and the class she participated throughout the year was a 4th grade class with 18 students. The coursebook studied was *Incredible English 4* (Redpath, Morgan & Phillpis, 2007). She prepared her lesson plan on one of the units in the coursebook. The unit was titled as "Underwater Life" and it was about different types of fish. Her lesson plan focused on the achievement of the following goals:

- Students will be able to express themselves in the present time.
- Students will learn new words about aquatic life and some sea animals.
- Students will be able to talk about the characteristics of some sea animals using the Present Tense.

Zeynep's lesson plan proceeded as follows:

She would start the lesson by asking students some questions related to sea life such as "What is fresh water? What is salt water? Which animals live in salt water? etc." Then, she would teach new words about the aquatic life by using flashcards. Following the practice of the words, students, in groups, would do a quiz on their coursebook page. The quiz preceded a reading text. Students would read the text and check their answers on the quiz. Listening follows reading. Students would listen to the descriptions of two fish and circle the ones described among seven pictures of other fish. Following that, Zeynep would introduce a task. She would say a new aquarium was going to be opened at a shopping mall in Istanbul and the authorities wanted each school to suggest a fish to bring. Thus, each student would prepare a catalogue for the fish of their choice. Zeynep showed her own catalogue for the fish "ray." Students were asked to work in pairs, choose a fish among the ones suggested by the teacher, and prepare a catalogue for it with text and pictures. Students would use Wikipedia for gathering information and pictures. When the catalogues were ready, students presented them

in front of the class. They would choose the fish to be in the aquarium by voting.

For the first category of the instrument, Zeynep received 4, i.e., "technologies used in the lesson are strongly aligned with one or more curriculum goals." The curriculum goals stated that students would talk about fish in the present time by using the vocabulary they had learned. Here, the choice of Wikipedia as the technological tool matches these goals as students need some information and pictures to be able to describe a fish. Wikipedia provides them with the information they need for the catalogues.

Zeynep's lesson plan would receive 4 for the second category of instructional strategies and technologies. In the plan, it is stated that students would work in groups and prepare a catalogue. Then they would present it to their peers. This means that students would be actively involved in the learning process. Using the Wikipedia to gather information for their catalogue would support the active role of the students and give them the responsibility of their own learning.

The third category focused on matching technology to both curriculum and instructional strategies. Considering her lesson plan, Zeynep's score for this category would be 4. The use of Wikipedia (technology) provided students with the necessary input for their catalogues (curriculum goal) and gave them the responsibility of their own learning (instructional strategy).

In terms of the fit among curriculum, pedagogy and technology, it can be said that Zeynep's score is 4. These three components in her lesson plan worked altogether to improve the quality of the lesson. The curriculum goals implied that students would use English for real purposes. Working in groups supported the authentic use of the language and the use of Wikipedia made it possible for learners to use the technology themselves, gather the necessary information and then present it to their peers in English.

For both the fourth and fifth categories about the implementation of the lesson plan

Zeynep scores can be 4. In terms of the instructional use of technologies, Zeynep's use of technology in the classroom was "maximally effective." Her technology use was transparent and it was integrated into the lesson smoothly. Students were very motivated to prepare a brochure and they wanted their fish to be the most voted, so their attention was not on the technology itself. Plus, Zeynep directed them to the simple English version of Wikipedia which supported their understanding and improved the quality of their catalogues.

Finally, in terms of operating technologies during the lesson, Zeynep and the students operated technologies very well in the observed lesson (receiving 4). Zeynep was very good at directing the students to Wikipedia, helping them to find their fish, monitoring them while working in groups and helping them when they needed. Some students had difficulty in finding the entry for their fish. She helped them with the search part and then left them for the group work. Students wrote some information they got from the Wikipedia on their catalogues and drew the picture of their fish by looking at the pictures on the page. On Wikipedia, some pages of the fish did not contain any pictures. In that case, Zeynep helped them to go to Google and search for the pictures of their fish.

Summary of the case 3. Zeynep's responses to the TPACK questionnaire at the beginning of the study showed that she had a medium level of TPACK. The qualitative analysis of her reflections before the treatment showed that her comments mostly focused on the relationship between technology and pedagogy but not on the combination of technology, content and pedagogy. As the study progressed, some improvement in her TPACK (0% at the beginning, 7.5% during and 18.5% at the end of the study) could be observed though her TPK continued to be the most dominant topic of her reflections. Finally, the analysis of her lesson plan and the field notes taken during observation of its implementation showed that Zeynep could reflect her developed TPACK in her planning and teaching processes. Her technology

choice was with a purpose. She considered the affordances and the constraints of the technologies and focused on their match to her context. Her technology use was smooth and transparent. It was in harmony with content and pedagogy. She looked very confident and eager to use technology. She could persuade the students with her enthusiasm. Thus, her lesson was a good example of a technology integrated lesson which facilitated the learning of students.

4.2.4. Case 4: Nil.

Nil had a medium level of self-reported TPACK according to the results of the TPACK questionnaire. Her practicum school was an Anatolian high school. She attended a Grade 9 class with 26 students.

Research Question 1. The following table shows the percentages of Nil's coded data for the seven categories of TPACK and the figure 12 shows the change in these percentages throughout the study.

Table 9

Percentage of data segments assigned to each coding category for Nil

		CK	PK	TK	PCK	TCK	TPK	TPACK
Before	Reflection 1	0.0	0.0	0.0	0.0	0.0	100	0.0
	Reflection 2	0.0	21.8	7.9	0.0	0.0	70.3	0.0
		0.0	**10.9**	**4**	**0.0**	**0.0**	**85.2**	**0.0**
During	Reflection 3	0.0	34	0.0	14.6	0.0	34.9	6.8
	Reflection 4	0.0	0.0	0.0	0.0	0.0	63.9	0.0
	Reflection 5	0.0	59.1	0.0	18.3	0.0	8.7	13.9
	Interview 1	0.0	18.4	0.0	32	0.0	0.0	31.4
	Interview 2	0.0	0.0	0.0	0.0	0.0	35.2	46.5
		0.0	**22.3**	**0.0**	**13**	**0.0**	**28.5**	**19.7**
After	Reflection 6	0.0	0.0	0.0	0.0	0.0	0.0	100
	Reflection 7	0.0	0.0	0.0	0.0	0.0	46.5	53.5
	Reflection 8	0.0	0.0	0.0	0.0	0.0	44.6	35.6
		0.0	**0.0**	**0.0**	**0.0**	**0.0**	**30.4**	**63**

Note. The rows do not total 100% because all coding categories are not presented here.

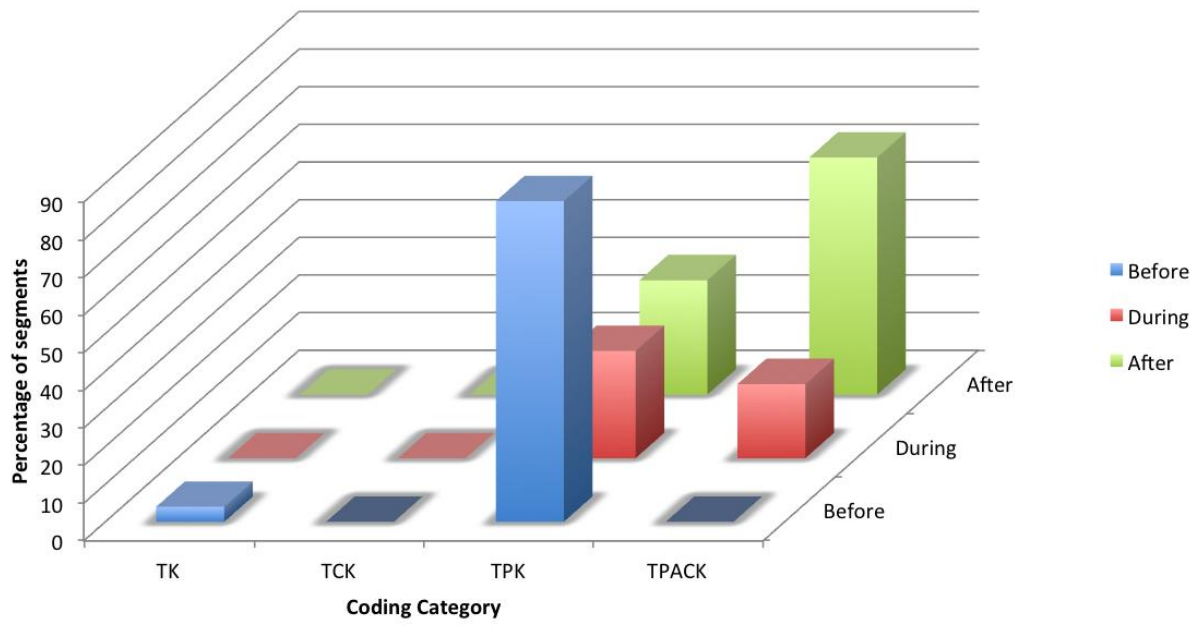

Figure 12. The changes in the technology related knowledge components of TPACK for Nil

Data coming from Nil showed that technology in relation to content and/or pedagogy was her focus throughout the study. Before the treatment, her comments reflected her knowledge of technology and pedagogy to a large extent (85.2%). Her PK was also evident in her reflections (10.9%). During the study, TPK could still be observed in her comments with a decrease (28.5%). Instead, Nil began to consider the integration of C, P and T (TPACK, 19.7%). At the end of the study, all her reflections showed that Nil moved from thinking about content, pedagogy and technology in isolation to thinking them all together, in relation to each other (TPACK, 63%). The following section discusses the data of Nil in detail.

Before the treatment

Nil's data collected before the treatment revealed that she considered technology in relation to pedagogy (85.2 %). None of her comments reflected her TPACK although she perceived that she had some TPACK prior to the study. Her pre-comments also reflected her PK (10.9 %) and TK (4%) though their percentages were very low. The following quotations illustrate these points:

> If I were asked to use this lesson plan in a real classroom I might have some classroom management problems as students are not used to being taught with technology. Their attention might be distracted and they may not focus on the lesson *(PK- Reflection 2).*

> In my plan I chose to use Msn Software as technology. While implementing this plan, technology use can be a problem for me. Connecting to the Internet, opening the program, connecting to the person and using the projector might be very difficult for me *(TK- Reflection 2).*

Students could give and receive feedback to each other as online portfolios were preferred to be used. This made the learning process more interactive. Students could improve both their own and their peers' learning *(TPK- Reflection 1).*

During the treatment

During the treatment, there were some changes in the focus of her reflections. While the instances of PK (22.3 %) and TPACK (19.7 %) increased, there was a sharp decrease in the instances of TPK (from 85.2 % to 28.5 %). Her comments also focused on PCK though rarely (13 %). Here are some of her comments showing these knowledge bases:

In the classroom, my main concern is to enable learning through collaboration. During my lesson, in addition to whole class teaching, I am planning to use group work and pair work to so that students can learn from each other *(PK- Reflection 3).*

I included some authentic listening and speaking tasks into my lesson plan so that students have the opportunity to collaborate with each other. I think language is for communication. Thus, students should use L2 in authentic contexts to exchange meaningful exchanges *(PCK- Reflection 3).*

After the feedback sessions, I have started to see technology as a solution to improve the quality of lessons not only as a cool way of teaching. I think the students liked the idea of creating a video and using Facebook. At the beginning, they hesitated but when they understood "why" they were all motivated and started working *(TPK- Interview after teaching).*

I used technology to facilitate my students' learning from each other and enable the

> use of language to communicate a message through an engaging task and chose the technologies I used keeping these two in mind *(TPACK- Reflection 5).*

After the treatment

Nil's comments after the treatment showed that she only focused on technology related knowledge bases, i.e., TPK and TPACK. Compared to the beginning of the lesson, there was a decrease in TPK (from 85.2 % to 30.4 %). While there was a decrease in TPK, dramatic increases could be observed with TPACK (0 % at the beginning of the study; 28.5 % during; and 63 % after the study). In other words, when the study ended, Nil could combine technology, content and pedagogy for effective technology integration and she stopped treating technology in isolation. The following quotations show Nil's TPK and TPACK:

> This project helped me to learn how to integrate the new technologies into teaching in order to improve its quality. I first think how a certain tool can be used in different ways. Then, I think how I can use it to improve students' learning *(TPK- Reflection 8).*

> The strategy that the teacher uses is very effective in solving the problem as the technology she chose does not only solves classroom management problems but also improves the quality of teaching. They all work together to solve the problem *(TPACK- Reflection 6).*

> The use of Msn in the lesson was a good idea if the underlying reasons of my choice were different. When I wrote the plan, my main concern was to attract the learners. Now I can say that Msn can be used for authentic listening and speaking tasks in the class so that students become active users of English. They learn to employ various communication strategies to make themselves understood *(TPACK- Reflection 7).*

Research Question 2. The classroom Nil attended at her practicum school was a ninth grade class and they used Upstream A2 as their coursebook. Nil was assigned by her supervisor at the school to prepare a lesson plan on the unit called "Great Gadgets." The unit began with two matching activities which asked students to match the pictures of some gadgets, first, with the words describing them, then, with the given uses such as "store songs and help you to sing along."A reading activity followed. Students were asked to read the texts and answer some questions. In the speaking task following reading, students were asked to imagine that they advertise gadgets on TV. They were supposed to produce a text like the ones in reading and then present it to the rest of the class. The unit ended with some grammar. Students were taught the order of adjectives and asked to practice it.

The classroom Nil attended had 25 pre-intermediate level students. The classroom had a traditional seating arrangement and the technological devices available were a projector and a tape-recorder. Nil's stated goals for the lesson were as follows:

- Students will be able to use vocabulary related to technology to describe a high tech device.
- Students will be able to use adjectives in a correct order to describe a gadget to create an advertisement about it.

Here is the evaluation of her lesson plan and its implementation according to Technology Integration Observation Instrument in terms of the quality of technology integration based on the TPACK framework: For the first category focusing on the match between technology use and curriculum goals, Nil's lesson plan was analyzed in detail. As mentioned above, she had two main objectives: Students would describe a gadget and while doing that they would use appropriate vocabulary and correct order of adjectives. In order to achieve this goal, Nil decided to integrate technology into the speaking task. She wanted the students to create a video to introduce and advertise their gadgets. They would upload those videos on a Facebook

page created by the teacher, share them with their friends, vote each other and be voted. Considering the match between the lesson goals and technology use, Nil would receive 4, which means technologies used in her lesson are “strongly aligned” with one or more curriculum goals.

For the match between instructional strategies and technologies it can be said that Nil matched these two effectively (receiving 4- “technology use optimally supports instructional strategies”). Creating a video of their gadgets, uploading them on Facebook, voting and commenting on each others’ videos require students to be actively involved in the learning process. When her plan was analyzed, it was seen that Nil planned to give students the responsibility of their learning. Students would work in groups collaboratively. Thus, her technology choice matched the instructional strategies she planned to use.

For the third category “matching technology to both curriculum and instructional strategies” it can be said that Nil’s technology choice matched her curriculum goals and instructional strategies. Using video and Facebook enabled students to work themselves collaboratively and express themselves in English. As the curriculum goals in her plan stated, students were supposed to learn how to describe a technological gadget by using relevant vocabulary and with the correct order of adjectives for different purposes. Thus, her choice of technologies was “exemplary, given curriculum goals and instructional strategies (receiving 4).

Considering the fit among curriculum, pedagogy and technology, Nil’s lesson plan can be an example of a “strong fit” (receiving 4) As discussed above, using video for recording and Facebook for sharing was a good choice to make students create their own gadgets, describe and advertise it using the newly learned vocabulary in groups. Each choice; curriculum goals, group work and the selected technologies all supported each other.

The last two categories were about the observed lessons. The first one referred to

"using technologies effectively for instruction." During her lesson, Nil used the CD of the unit in the classroom and explained how students were supposed to create the videos and share them on Facebook. Her CD use was OK (receiving 2). She smoothly integrated it into the flow of the lesson and gave instructions clearly. The only problem was playing the CD only once. Though most of the students completed the activity, there could be some students who could not. Due to the lack of technological facilities in the classroom, Nil only instructed the students on how to do their video recording and how to share them on Facebook. Her explanations were adequate but not very effective. She did not emphasize the purpose of using Facebook. Rather than emphasizing its use for sharing, she more focused on its popularity.

For the final category referring to teachers' and/or students' operating technologies, Nil would receive 3. She had no problems in using the CD player technically. Her explanations about the tasks in which students would produce language using technology was adequate. She explained how long the video could be, which devices they could use, how to upload their videos on Facebook, etc. Students were not observed using technology due to the lack of technologies in the classroom.

Summary of Case 4. Nil's perceived level of TPACK was medium prior to the study. However, none of her comments reflected her TPACK though she did not consider technology in isolation but in relation to pedagogy (85.2 %). As the study progressed, her focus on TPACK increased (19.7 % during the treatment and 63 % after the treatment). At the end of the study, none of her comments showed that she focused on content, technology or pedagogy in isolation.

In relation to Nil's lesson plan and its implementation, it can be said that she considered technology, pedagogy and content all together reflecting her TPACK. Her aim of technology use was to improve the quality of teaching and learning. She considered the needs

of the students, her curriculum goals and the technologies that best suited her needs in the planning process. In the implementation of her lesson, she was confident about the technology she was familiar with, i.e., CDs. For the other tasks, she preferred her students to use the technologies to produce language rather than herself. She tried to explain them in detail, though she was rather excited while telling students how to use them. This can be because of the fact that neither Nil nor the students at the practicum school were not used to using technologies such as video recording or Facebook for educational purposes.

In short, it can be said that Nil effectively integrated technology into her lesson plan and followed a matching pedagogy in which students worked collaboratively to produce language.

4.2.5. Case 5: Özlem.

Özlem was one of the two cases who had a self-reported high level of TPACK. She did her practicum at a state Anatolian high school and attended a grade 9 class with 28 students.

Research Question 1. Table 10 shows the percentage of coded segments for the seven categories and the Figure 13 indicates the changes that occurred in her knowledge bases as the study progressed.

Table 10

Percentage of data segments assigned to each coding category for Özlem

		CK	PK	TK	PCK	TCK	TPK	TPACK
Before	Reflection 1	0.0	31.9	0.0	0.0	0.0	68.1	0.0
	Reflection 2	0.0	0.0	0.0	0.0	0.0	15.7	84.3
		0.0	**15.9**	**0.0**	**0.0**	**0.0**	**41.9**	**42.1**
During	Reflection 3	0.0	36.7	5	4.3	0.0	45.2	8.8
	Reflection 4	5.7	0.0	0.0	0.0	7.5	16.9	27.9
	Reflection 5	0.0	19.1	0.0	19.1	0.0	10.8	41.7
	Interview 1	0.0	32.7	27.1	14.4	0.0	13	18.6
	Interview 2	0.0	30.5	15.6	10	0.0	17.2	18.8
		1.1	**23.8**	**9.5**	**9.5**	**1.5**	**20.6**	**23.1**
After	Reflection 6	0.0	0.0	0.0	15.4	0.0	0.0	84.6
	Reflection 7	0.0	0.0	8.1	10.9	0.0	15.2	60.5
	Reflection 8	0.0	0.0	12.5	0.0	0.0	4.5	60.9
		0.0	**0.0**	**6.9**	**8.8**	**0.0**	**6.6**	**68.7**

Note. The rows do not total 100% because all coding categories are not presented here.

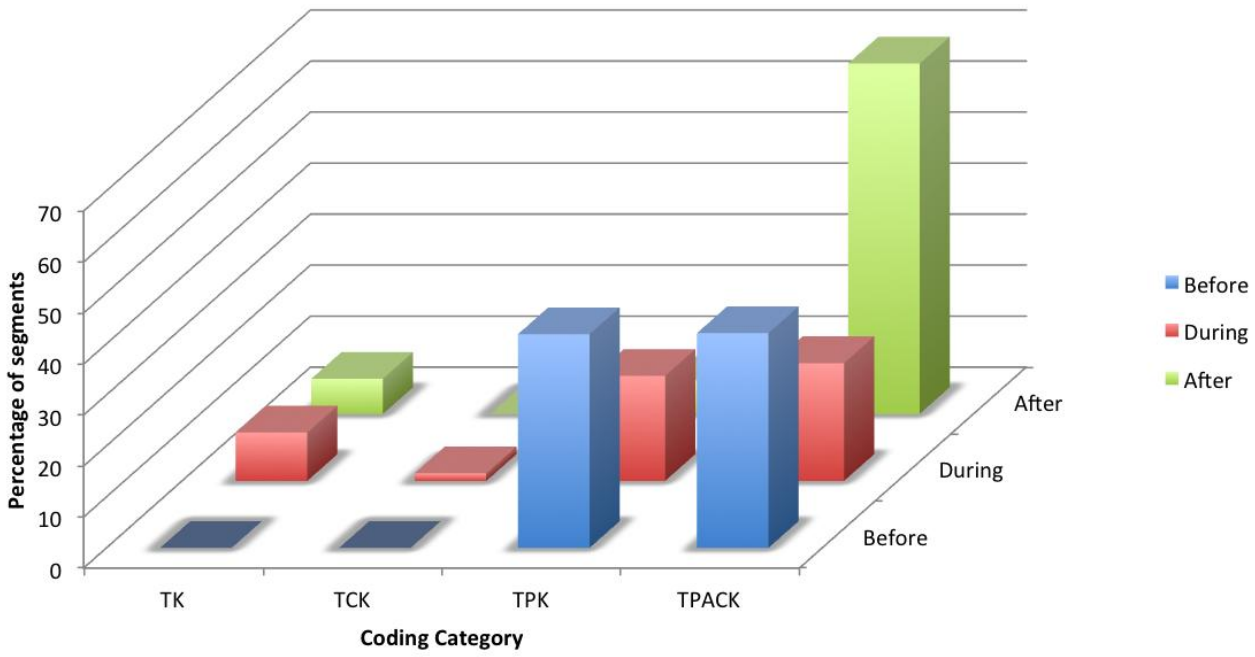

Figure 13. The changes in the technology related knowledge components of TPACK for Özlem

Özlem's data revealed that she began the study with a high understanding of the relationship between pedagogy and technology (TPK, 41.9%) and between content, pedagogy and technology (TPACK, 42.1%). During the study, the majority of her comments continued to reflect her TPK (20.6%) and TPACK (23.1%). Finally, when the study ended, Nil had a more coherent understanding of technology integration (TPACK, 68.7%). The details are discussed below.

Before the treatment

The Table 10 above shows that, before the treatment, three knowledge bases could be observed in Özlem's data: PK, TPK, and TPACK. In the very first week, Özlem's comments revealed that she considered technology, content, and pedagogy together (TPACK, 42.1 %). Besides TPACK, instances of TPK were also observed at a very high level (41.9 %) implying that Özlem did not consider technology in isolation but in relation to pedagogy and content. The only knowledge base she focused on in isolation was PK (15.9 %) which reflected her concerns about the students.

The following quotations from the reflections of Özlem show her knowledge of PK, TPK and TPACK:

> I think the reason of students' problem behaviours is the way the teacher handles the group work. As the students do not find the group work activities attractive, they become off-task *(PK- Reflection 1).*

> As the idea of sharing their work with their friends and using the Internet attracted students' attention and motivated them to participate in this study, they understood each other better and the study had positive results. In other words, the teacher used

technology in order to improve students' attitudes towards each other and the lesson and to increase their motivation *(TPK- Reflection 1).*

While this plan is being implemented, the teacher may face some technology related problems. The computer might not work or electricity might go off. If such problems occur during the lesson, the teacher might lose a lot of time and the lesson may not go as planned. The teacher may have difficulty in managing these problems *(TPK- Reflection 2).*

While planning my lesson, first of all, I considered the age of my target students who are six graders. As they are young learners, their attention span is short. Thus, I planned to use technology to keep their attention on the lesson. The second thing that I considered is my objectives. I have tried to choose the most suitable types of technology which help me achieve my goals. The last thing I have considered is how practical the application will be. The type of technology should be applied easily. I have planned to use some powerpoint slides, video and some photos by using a projector and an OHP in the warm up session of the lesson to take the attention of the students at the beginning of the lesson. The second reason of using video is that it is suitable for my objective as my goal is exposing the students to the use of the target vocabulary in real life. Therefore, using video helps me achieve this goal. Reflecting the pictures and text on the board by using an OHP is more economical and practical than giving handouts. Giving handouts can also cause us to lose time, so reflecting the materials by an OHP enables us to use the teaching time effectively. This is the reason in my using an OHP and transparency in my last activity as well *(TPACK- Reflection 2).*

During the treatment

When Özlem's data collected during the treatment were analyzed, it was seen that she demonstrated all seven types of knowledge: CK, PK, TK, PCK, TCK, TPK, and TPACK. While her CK, TK, PCK and TCK had lower percentages (1.1 %, 9.5 %, 9.5 %, and 1.5 % respectively) in her data, her PK, TPK and TPACK received higher percentages (23.8 %, 20.6 %, 23.1 %, respectively). Although there was a decrease in her TPACK, she still did not consider technology in isolation. The following comments illustrate these points:

> In the coursebook, there were two warm-up activities: matching and listening. Following the warm-up, in relation to the reading text, there was a pre-reading, post-reading (in the form of a True/False activity), a speaking and a writing activity *(CK- Reflection 3).*

> I prepared the instructions I would be giving before teaching and wrote them down in my plan. However, as I was very excited while teaching, some of my instructions were either too long or vague. If I could repeat this lesson, I would be more careful about the instructions *(PK- Interview after teaching).*

> I may experience some technical problems during the lesson. For example, if the projector doesn't work appropriately, it will be a serious problem for me while doing my warm-up activity, because I don't know how I can fix problems with a projector *(TK- Interview before teaching).*

> In the final activity of preparing a postcard, the students tried to use all the words they had learned. While discussing with their group member I observed them to see what

they were discussing about. In one group, one of the students used the word "driver" while referring to the person using sled in sled dog races. His peer corrected her immediately by saying she should use "musher" not "driver." Based on such comments and the postcards they produced, I can say that my lesson reached its objectives and students learned very well *(PCK- Interview after teaching).*

In the first version of my plan, I replaced the pre-reading matching activity and post-reading True/False and speaking activities with some technological tools such as video and power point slides. Based on the feedback I got from my teacher and friends, I changed the problem I focused on and decided to use technology to address that new problem *(TCK- Reflection 4).*

While I was choosing the technology to solve the problem I focused on, first of all I kept in mind the facilities available in the classroom. There isn't internet connection in the class so the technological tools which require internet connection are not suitable for me to use in the class. That's why I choose to use a video. It does not require any internet connection, it is suitable to use with my activities and what is more important that I think it will motivate students to participate by attracting their attention. This is the affordance of video, but it is used by the teacher. I also wanted students to produce something themselves by using a technology so I choose to assign them to prepare a brochure related to our topic by using Microsoft Office Publisher. After they prepare their brochures, they send their products to me and I will share the products with all students on the blog which I will create for the class. I choose to share the products on the blog because it is a suitable tool to get the students to see their friends' product. I think if the students know that their friends will see their products, they will give more

importance to the task and do it more carefully and willingly *(TPK- Interview before teaching)*

While I was planning my macro-teaching lesson, I replaced some of the activities in the unit with technology. However, when I received the feedback, I realized that replacing the activities with technology did not solve the problem in the unit. In other words, I saw that I had used the technology for the sake of using it. During the feedback session, when I was asked why I made those changes and used those technologies, I realized that I had no justification and I used the technology just for the sake of using it *(TPK- Reflection 4).*

I should state that using technology requires a lot of time and effort. Finding the video, cutting it using a software, preparing a draft by using Microsoft Office Publisher as an example, etc. took such a long time that doing all these without a purpose is meaningless. Before deciding to use technology, we should definitely evaluate if the potential gains are worth all that effort *(TPK- Interview before teaching).*

While I was choosing the technologies that I would use in my macro-teaching, I considered the facilities in the classroom, the affordances and constraints of each technological tool I was planning to use, my objectives, how each technological tool can solve my problem(s) and how it will be suitable to use them in the tasks that I will use *(TPACK- Reflection 5).*

After the feedback sessions, I learned to ask the question of "why" to the technologies I use. I really liked learning this. I knew that I had problems about the use of

technologies but during these feedback sessions I solved this problem. Actually, I was always good at technology in theory. When it came to application, I realized my weaknesses and improved them. I learn how to think from the feedbacks I received *(TPACK- Reflection 4).*

I learned how to find the problems in course materials, how to consider different factors, how to focus on teaching the content, how to select appropriate technologies, and how to integrate technologies with content and pedagogy to maximize students' learning *(TPACK- Reflection 5).*

After the treatment

The analysis of Özlem's data after the treatment showed a dramatic increase in her TPACK (68.7 %) which means that she treated technology, content and pedagogy together. Other than TPACK, some of her comments reflected her TK, PCK and TPK (6.9 %, 8.8 %, 6.6 %, respectively). The quotations below show how she reflects her knowledge in her data:

I realized that, prior to the study my understanding of technology was limited to powerpoint and overhead projector! In this study, I learned to learn about technologies. We have learned a number of technologies in this study but new technology is emerging so fast that it is very difficult to catch up with every new technology. Thus, what is important is to learn how to learn about technologies in general. Before the study, I was not very confident about learning new technologies. Instead of learning how to use it myself, I always expected someone else to teach me how to use it. Now it is different. When I hear a new technology, I try to discover it myself *(TK- Reflection 8).*

Students are not used to the idea of group work, but writing is best done in groups. Students can help each other and learn from each other. Writing in another language is a difficult process but when students help each other, their learning is facilitated *(PCK- Reflection 6).*

In my initial lesson plan, when I asked students to watch and listen to the power point slides I prepared, I did not give them a reason to watch or listen to. What did slides offer to the students? Why did I choose slides both not other technologies? I did not consider these then *(TPK- Reflection 7).*

She chose a very suitable technological tool to her students' problem, to the classroom context and to the content of the lesson. Her technology use solved her problem very effectively. The most important point is that this technological tool did not distract the students. Instead, it solved the problem, enhanced their learning process and maximized their learning *(TPACK- Reflection 6).*

At the beginning of this study, we received some theoretical information on TPACK. I thought I understood the idea of TPACK and I could easily apply it in my teaching. However, the real change in my perspective of technology integration happened when I actually used technology for teaching purposes. Before this study, I used technology without having a specific purpose. I did not think whether my technology use would support students' learning, would help me to achieve lesson objectives, or whether the technology I select fits the content I am teaching, is suitable to the classroom content and meets the needs of the students. But now I do *(TPACK- Reflection 8).*

Research Question 2. The lesson plan and the video recording of Özlem's actual teaching were analyzed in detail to see how TPACK is reflected in her instructional practices.

Özlem designed her lesson plan on a coursebook unit titled 'Fit for Life' from Upstream Pre-intermediate Coursebook by Evans and Dodey (2006). The unit was about dog races in Alaska. The unit began with Lead-in section introducing the topic in general. Then came the listening section in which students were to listen to different dialogues and guess the sport in each. The next section was Reading with its pre-reading, i.e., guessing the topic of the article and post-reading activities, i.e., discussion, true/false, speaking and writing.

In the classroom she attended for her practicum, there were 28 pre-intermediate level students. The classroom was using a traditional seating arrangement and as technology, only a projector and audio-tape were available for use in the classroom. As a general goal, Özlem stated the following: "Students will practice four language skills and broaden their active vocabulary knowledge." For specific objectives, the following were listed in her plan:

- Students will internalize and will be able to use appropriate adjectives and language items to describe a sport, its requirements, its difficulties and possible feelings experienced while doing it.
- They will be able to understand and talk about what they hear and/or read about the sled dog race.
- They will be able to write a postcard and express their feelings by using appropriate vocabulary and language items.

In order to achieve these objectives, Özlem used a computer, projector, speakers, a Movie-maker software, and Microsoft Office Publisher software as digital technological tools.

In order to decide whether the goals Özlem stated in her plans and the technologies she

used matched well, first, Özlem's stated goals and the technologies she chose were analyzed.

Özlem stated in her lesson plan that at the end of the lesson, students would have gained detailed information about the sled dog race, the topic of the reading passage. As one of the pre-reading activities, she planned to use a video. The aim of pre-reading activities are to build and/or activate students' background knowledge, thus, her use of a video introducing the races matches her goal. As her general goal, she also stated that students would be practicing four language skills and improving their vocabulary. By reflecting on the video and by relating the video to the key words given by their teacher, students practiced their speaking and vocabulary skills.

Özlem also wrote in her lesson plan that students would be able to talk about a sport, its requirements, difficulties and their feelings about a sport using the vocabulary they learn during the lesson, both orally and written. To achieve her goal, Özlem decided to show students how to use Microsoft Office Publisher software, so that they would prepare their postcards as a post reading activity and post them to the classroom blog. In the classroom, students would work on their drafts and then they would prepare their postcards using the software at home. Here, Özlem's technology choice matches her goals. While working on the draft of their postcards in the classroom, students might communicate with and get help from each other. The idea of creating their own postcards and sharing them with the others on a blog would motivate students to complete the task. Based on these examples, it can be concluded, for the first category, that technologies used in her lesson are "strongly aligned" with one or more curriculum goals receiving 4.

The second category of "instructional strategies and technologies" refers to "matching technology to instructional strategies." In other words, the aim is to understand whether the technology used and the pedagogy match each other. When Özlem's plan was observed, it was seen that she wanted her students to actively participate into the lesson. Because of the

lack of technological facilities in the classroom, she planned to use the technological devices in the classroom herself. For example, she planned to use the video herself. Students would watch and comment on the video. She also wanted the students to prepare their postcards using the Microsoft Office Publisher software. She demonstrated how to use it in the classroom using her own computer. Students would use the software at home. This was the solution she found to make students actively involved in the use of technology. Based on these examples, it can be concluded that Özlem's technology use supported her instructional strategies which were based on the active role of the students in the learning process (receiving 3).

The third category in the observation instrument is "technology selection(s)." This category refers to "matching technology to both curriculum and instructional strategies." Considering the curriculum goals in her plan and instructional strategies she used, it can be said that Özlem's technology selections are "appropriate, but not exemplary, given curriculum goal(s) and instructional strategies." For example, at the beginning of the lesson, she planned to play a video showing a sled dog race to introduce the topic and to build students' background knowledge. However, the video she chose did not have any speech but music. The video would give students an idea about the races but not introduce them with the relevant vocabulary or phrases. Except the quality of this video, as discussed above, the technologies she selected matched her lesson goals and pedagogical strategies.

The fourth category "fit" referred to the "fit" of curriculum, pedagogy and technology. Özlem receives 4 which means "curriculum instructional strategies and technology strongly fit together within the lesson." When her plan was observed, it was seen that when she used technology to achieve her objectives, she also tried to match her pedagogy as long as the technological facilities allowed. For example, when she decided to use the Microsoft Office Publisher, she wanted her students to be active and create their own cards. Thus, she assigned

it as homework. She also wanted her students to share their postcards with each other. For this, she wanted students to put them on the blog she opened for them, read each other's postcards and comment on them. As one of the stated goals of her lesson was to make students practice language skills, this example technology use of her shows a fit among technology, content and pedagogy.

The fifth category "instructional use" refers to using technologies effectively for instruction. Özlem's instructional use of technology can be considered effective (receiving 3) in the observed lesson. The way she integrated the selected technologies into her lesson was effective and her technology use, in general, was smooth. When she used the CD of the coursebook, she introduced the activity to the students clearly. She explained, in detail, what they were supposed to while and after listening. The activity was successfully completed. When Özlem introduced the task of preparing a postcard, she tried to explain how they could use Microsoft Office Publisher software by using her personal computer. She spent too much time on that and it was difficult for the students to focus back on the task later. She repeated the task and, then, the students began working on it. Considering these, it can be concluded that by using technology, Özlem improved the effectiveness of her lesson.

The final category of "technology logistics" refers to teachers' and/or students' operating technologies. In the observed lesson of Özlem, she operated technologies well (receiving 3). Her use is not considered to be "very well" as she had difficulty in operating the software to demonstrate students how to use it at home to prepare their postcards. As students did not use technology in the classroom, their technology use cannot be evaluated.

Summary of Case 5. To summarize, Özlem had a high level TPACK according to the findings of the TPACK questionnaire. Her reflections at the beginning of the study supported this finding. Her initial comments reflected her TPACK before she was exposed to the

treatment (42.1 %). The qualitative analysis of her reflection at the end of the study showed that, after the treatment, there was an increase in the percentages of the data reflecting her TPACK (68.7 %). From her comments, it could be observed that, she considered technology, content and pedagogy together and considered these components all together while planning and implementing a lesson.

Based on the field notes kept during the observation, it can be said that her technology use was not at a mechanical level. It matched her curriculum goals and she modified her pedagogy. While choosing the technological tools, she considered their affordances and constraints and the facilities in the classroom. During her teaching, she tried to make her technology use as transparent as possible and achieved this to some extent. Therefore, it can be concluded that, she demonstrated her TPACK in her actual teaching experience.

4.2.6. Case 6: Hande

Hande was one of the two PTs who had a reported high level of TPACK according to her responses in the TPACK questionnaire. Her placement school for practicum was a private primary school. The class she observed throughout the practicum was a third grade class with 24 students who had been learning English since kindergarten. They were using the coursebook called *Backpack 3* by Pearson-Longman (Herrera & Pinkley, 2010).

Research Question 1. The following table shows the percentages of Hande's coded data for the seven categories of TPACK.

Table 11

Percentage of data segments assigned to each coding category for Hande

		CK	PK	TK	PCK	TCK	TPK	TPACK
Before	Reflection 1	0.0	0.0	0.0	0.0	0.0	0.0	100
	Reflection 2	0.0	0.0	0.0	14.7	0.0	54.5	30.8
		0.0	**0.0**	**0.0**	**7.4**	**0.0**	**27.3**	**65.4**
During	Reflection 3	0.0	0.0	0.0	19.6	0.0	15.3	65.1
	Reflection 4	0.0	0.0	0.0	0.0	0.0	0.0	16.8
	Reflection 5	0.0	51.1	0.0	16.3	0.0	13.9	14.5
	Interview 1	0.0	19.2	15.7	0.0	0.0	0.0	47.6
	Interview 2	0.0	0.0	0.0	0.0	0.0	32.4	51.3
		0.0	**14.1**	**3.1**	**7.2**	**0.0**	**12.3**	**39.1**
After	Reflection 6	0.0	0.0	0.0	0.0	0.0	0.0	100
	Reflection 7	0.0	0.0	0.0	0.0	0.0	0.0	100
	Reflection 8	0.0	0.0	8	0.0	0.0	0.0	41.2
		0.0	**0.0**	**2.7**	**0.0**	**0.0**	**0.0**	**80.4**

Note. The rows do not total 100% because all coding categories are not presented here.

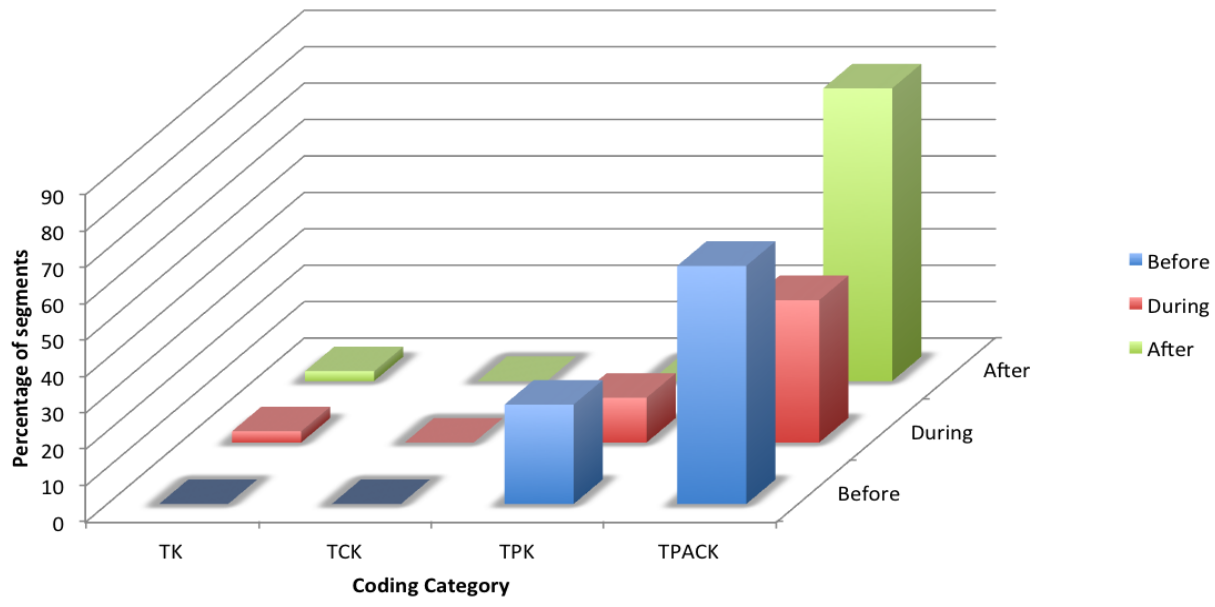

Figure 14. The changes in the technology related knowledge components of TPACK for Hande

Hande's data showed that she had a deep understanding of the relationship between content, pedagogy and technology at the beginning (65.4%), during (39.1%) and at the end of the study (80.4%). Her comments reflected that she always considered content, pedagogy and technology in relation to each other to improve the quality of teaching. The following section discusses Hande's data in detail.

Before the treatment

Before the treatment, Hande's reflections revealed that, parallel to her self-perception, she had a high level of TPACK (65.4 %). None of her comments showed her thinking of the knowledge bases in isolation. In addition to TPACK, some PCK (7.4 %) and TPK (27.3 %) could also be observed in her reflections. Here are the quotations showing Hande's knowledge bases:

> For my lesson plan, visualization is very important in terms of making students comprehend the vocabulary items better, so I plan to use a handout on which different professions are shown. I also included a song for students to sing and move as they are kinaesthetic learners and learn better by doing *(PCK- Reflection 2).*

> As a post activity to the song, I would ask students some questions which they can answer on a computer in the classroom. Coming to the board to use the computer would motivate them for the lesson *(TPK- Reflection 2).*

> The teacher in the case solved her problems by using technology. More specifically, the use of online portfolios helped her motivate students for writing. Students' writing quality improved and the classroom management problems were solved too *(TPACK-Reflection 1).*

During the treatment

Some changes could be observed in Hande's data during the treatment. While some of her comments reflected that she considered pedagogy (14.1 %) and technology (3.1 %) in isolation, the majority of her comments still focused on the combination of the knowledge bases as follows: PCK (7.2 %), TPK (12.3 %) and TPACK (39.1 %). This means that her discussions related to the lesson planning and implementation processes mostly focused on content, pedagogy and technology together. The following comments of Hande show how she thought during the treatment:

> I had problems because of my instructions. Students did not understand some of my instructions. They began talking to each other as they were confused. I had to repeat the instructions for the activities many times. It was very tiring for me *(PK- Reflection 5).*

> In the lessons I participated for observation at my practicum school, I observed that teachers use songs and chants just for fun not as teaching materials. I think songs and chants are good teaching materials especially for young learners as students can hear the new language in context and learn it by singing *(PCK- Interview before teaching).*

> When I decided to use podcasting in my lesson plan, I, first, thought about the students: their needs, interests, language level and age. Then considering the affordances and constraints of technologies, I decided to use podcasting. I also considered my context too. I could use a computer, head speakers and an MP3 player to create a podcast in the classroom. Creating their own chant would attract the students, make them active and get them use English for some real purposes *(TPACK- Reflection 3).*

> I think my lesson reached its aim. The students were very creative. They enjoyed creating their own chants, sharing it with their friends and listening to their friends' chants. My technology use was transparent. The students' attention was on writing a good chant and singing it. They used English actively in context *(TPACK- Reflection 5).*

After the treatment

At the end of the study, Hande's comments mostly focused on TPACK (80.4 %). Although she also mentioned technology in isolation (2.7 %), this was very limited in amount. Hande's comments reveal her thinking at the end of the study:

> Before the study, technology meant to me a projector or an OHP, and a smart board. I was not familiar with the technologies such as blogs, wikis or webquests. Now I feel competent in using all these new technologies *(TK- Reflection 8).*

> When I look at the lesson plan I wrote at the beginning of the study, I see that I used technology for the sake of using it. I did not think whether the technology I chose, the content, the level of the students, their age and my teaching supported each other or not *(TPACK- Reflection 7).*

> I feel that I have got TPACK now. When I am asked to plan a lesson, I remember to focus on a problem and think about ways of preparing an effective lesson. I first look at my content and ask myself some questions: What do I want to achieve? How can I help my learners learn better? Then I try to choose the technology that will help me to achieve my goals. Simultaneously, I plan how I am going to teach. All should be in harmony *(TPACK- Reflection 8).*

Research Question 2: Hande's lesson plan and its implementation at her practicum school were analyzed to answer the second research question. As mentioned above, Hande's class at her practicum school was a third grade class with 24 students. Hande used a chant from the students' cousebook *Backpack 3*. The chant was about professions. The lesson proceeded as follows: Students listened to the chant about the professions. Then, the teacher gave students a handout on which there were statements like "I will/won't be a soccer star" and "I will/won't make a cinema film." Students ticked the sentences that suited them and then asked their partners for their opinions. Following that, students created their own chants consisting of four lines and in their chants they stated what they wanted to do in the future. When they were ready, each student came to the board and sang their chant to the teacher who recorded them. The teacher played the recordings one by one. The others listened to the chants and tried to find the most popular profession in the classroom. Hande used a computer and an MP3 player as technological devices. Her stated goals for her lesson were as follows:

- Students will be able to talk about future plans.
- Students will be able to use different forms of "will" to talk about future.
- Students will be able to comprehend what they listen to.

The first category of the instrument focused on the match between technology and curriculum. Hande would receive 4 from this category. As a curriculum goal, she aimed to get students to talk about future using "will" and to improve their listening skills. Playing a chant which provides a model for language use, recording students singing their own chants, asking students to listen to each other's chants all contribute to the achievement of these goals.

For the second category, Hande would receive 4 too which means "technology use optimally supports instructional strategies." Hande wanted the students to talk about their future plans so that they could be active in using the language. She planned to ask them to create their own chants and sing it. Creating and singing a song would attract young learners

very much. This way, they would be motivated to talk about their future professions, learn how "will" is used to express future and improve their listening skills by being involved in the process.

The third category focused on matching technology to both curriculum and instructional strategies. Hande's score would be 4 considering her technology choice. As discussed above, her choice of technology matches her curriculum goals and supports her pedagogy of communicative teaching in which students are active users of the language.

Considering the fit among content, pedagogy and technology, Hande's lesson can be considered as a good example and receive a score of 4 out of 4. These three components supported each other throughout the lesson. Recording the students would motivate them and increase their participation. They would use English for communicative purposes and practice talking about the future.

The fourth and fifth categories are about the implementation of the lesson plan. In practice, Hande's use of technology was very effective (receiving 4). Her integration of the technology was very smooth and in a good harmony with her general teaching. Seeing an example chant at the beginning of the lesson prepared students for the next task, recording their chants gave them a reason to produce language and sharing their chants with the rest of the class provided students with authentic listening materials. Thus, Hande's instructional use of technologies can be considered as maximally effective.

Finally, in terms of operating technologies during the lesson, Hande would receive 3, "teachers and/or students operate technologies very well in the observed lesson." At the beginning of the lesson, she could not play the CD so she had to read the chant herself. There were some times she felt uncomfortable about using the technologies, as she later explained, because of not being used to. For the implementation of her plan, it can be said that Hande tried to be transparent in terms of her technology use. She used the technologies herself

because of the age of the students and the nature of the content. Students were young learners, so she did the recording herself. Plus, the task required students to produce their own content and then get recorded. Thus, it can be said that, her pedagogy was in harmony with the content and technology.

Summary of the Case 6. Hande's comments on the TPACK questionnaire showed that she had a high level of TPACK. When her discussions were observed before the treatment, it was seen that her TPACK was evident in her comments (65.4 %). Throughout the study, she reflected her TPACK and demonstrated that, especially at the end of the study (80.4 %) technology integration for her was based on TPACK. Her quotations clearly reflected how she considered technology, content and pedagogy together with the aim of improving the effectiveness of her teaching. Her lesson plan and her lesson also proved that she could put her theoretical knowledge of TPACK into practice. Her choice of technology and its integration into the lesson all showed that she followed the TPACK framework. Hande stated after her lesson that teaching experience was one of the best parts of the project for her. She said she learned how to plan a lesson with technology but she did not know how she could put it into practice. She added that this experience strengthened her self-confidence and she would integrate technology into her future lessons.

4.3. Fieldnotes on the Coursework

The researcher took fieldnotes during the treatment for triangulation purposes. The reflective part of these notes will be presented here in detail to make the process of the treatment clear from the point of view of the researcher.

The first thing the researcher found out about the PTs was their understanding of technology integration prior to the study. For them, it only meant learning new technologies.

They stated that when they learned new technologies, they could have effective lessons. When they were introduced the term TPACK for the first time, they said that they had never considered technology in relation to content and pedagogy. Their starting point was always technology.

PTs were observed to like the idea of repurposing. They had not considered that technologies were usually repurposed, so they found the idea very interesting. While discussing the need for technology integration in today's world, they mentioned that their future students would expect them to use technology in English classes but they did not feel competent. When the importance of creativity was emphasized, they said that they were not creative as they had not been taught in creative ways. However, the repurposing project, which asked them to repurpose a technology, increased their self-confidence. Repurposing a technology and sharing it with their peers motivated them to a great extent. At the beginning of the study, the fact that there were a lot of new technologies to be learned stressed them. The majority of the PTs knew just few of the new technologies and they did not know how to cope with this. This project was totally based on volunteer participation of PTs. They explained that the reason why they participated into this study was their lack of technological skills for integration. It was their graduation year and they wanted to resolve this problem before they graduated. During the first weeks, it was observed that PTs' ambiguity of tolerance was low. Thus, they could not think flexibly. Because of this, they could not think different uses of the same technology. Their flexible thinking improved in time as they learned and practiced different uses of technologies.

When PTs began to present a technological tool in terms of its technical and pedagogical use to their friends, the researcher observed great changes in their attitudes, motivations and self-confidence. PTs used different techniques to introduce their tools such as videos or some software to their peers. This impressed the PTs and every week they worked

harder to improve the presentations of the tools. In the pedagogical examples they found for the tools they presented, PTs still followed traditional ideas. When the researcher gave some examples, they felt sad as they thought their own examples were not that creative. PTs said that when they were preparing for their tool presentations, they were excited. One of them said she had spent three days just to discover how the tool worked and was very happy about it. As they shared with each other, they became more motivated to learn about different tools.

As they presented their tools and listened to their peers' presentations, they began to observe the teachers using technologies in their practicum schools. They began to evaluate the use of technologies in the classrooms they observed and mostly said either most of the teachers did not use any technology or their technology use was too teacher-centred. Teachers used certain technologies for lecturing purposes. These comments revealed PTs' raised awareness of technology integration. Their self confidence got so high that most of the PTs said they would help their colleagues in their future schools in terms of integrating technology into English classes effectively.

When PTs were informed that they were supposed to prepare a technology integrated lesson for macro teaching at their practicum schools, they were very excited. One of the PTs said that he would use a blog in his lesson. His peers warned him immediately and said that he was being techno centric. This showed that PTs were aware of the relationship among content, pedagogy and technology.

After planning their lessons, PTs, first presented it to their peers. Then, based on the feedback they received, they modified the plan and taught at their practice schools. Sharing their plans with their peers was exciting for them. They said that receiving feedback on their plans improved the quality of their plans and they felt more confident while implementing the plans. They were observed to have one major concern: lack of technological devices. Most of the PTs did their practicum at state schools which lacked technological facilities.

During the feedback sessions, students' productivity and creativity increased. While listening to each other's plans, they asked some questions most of which focused on the reasons of technology choices of their peers. These questions made PTs question their plans. While some of the PTs could give a satisfactory explanation of their technology choice by referring to the content and pedagogy, some of them realized that they had chosen that particular technology for the sake of using it. These feedback sessions helped PTs a lot to improve themselves. As they observed others' lessons, discussed them, suggested new ideas, etc. their ability of integration improved. It was observed that, after few feedback sessions, PTs comments improved in quality. They started to give very valuable feedback to each other. In return, the quality of the lesson plans improved too. In other words, PTs listened to the feedback coming from their peers and used it to improve their plans. About the feedback sessions, PTs stated that, they found them very useful to improve the quality of their lessons. Hearing a lot of plans, thinking about them, discussing how to improve them increased the self-confidence of PTs too.

Following the feedback sessions, PTs modified their plans and implemented them at their practicum schools. As discussed in the previous sections in detail, PTs were observed to reflect their TPACK in their actual teaching.

It can be concluded that the treatment designed for the present study helped PTs develop and/or improve their TPACK and its technology related components which could be clearly observed in their actual teaching practice in a real language classroom.

CHAPTER V

CONCLUSION

The present study employed a mixed methods approach in order to answer the following research questions:

1. Will there be a significant change in the Technological Pedagogical Content Knowledge (TK, TCK, TPK and TPACK) of pre-service teachers of English as they participate in a design study?
2. Will pre-service teachers' TPACK (TK, TCK, TPK and TPACK) be reflected in their instructional practices?

In the first phase of the study, quantitative data were collected from 22 PTs at the beginning and end of the study using the Survey of Pre-service Teachers' Knowledge of Teaching and Technology (Schmidt, et al., 2009) in order to understand whether PTs' technology related knowledge changed after participating into the present study (Research question 1). Statistical analyses were conducted to investigate the pre- and post-test differences in technology related sub-scales of TPACK. These findings were presented and discussed in Chapter 4.

In the connecting phase of the study, six cases were selected among 22 PTs to better examine the changes in their TPACK. Pınar, Gözde, Zeynep, Nil, Özlem and Hande were the cases analyzed in detail. Chapter 3 presented the analyses used to select the cases.

In the qualitative phase of the study, the TPACK framework was followed. Specifically, first, TPACK a priori codes were established for qualitative content analysis to analyze the data coming from the six cases throughout the study (Research Question 1). Second, Technology Integration Observation Instrument, developed by Harris, Grandgenett, and Hofer (2010), was used in order to see how PTs' TPACK was reflected in their

instructional practices (Research question 2). The findings of the qualitative data were reviewed in Chapter 4.

The present chapter presents the summary of the data findings coming from the quantitative and qualitative analysis by referring to the relevant literature. Then the implications of the study and recommendations for future research are offered. Finally, the limitations of the present study are listed.

The quantitative data coming from the TPACK Survey was analyzed using Dependent means t-test which was applied to the technology related knowledge domains of the TPACK in order to understand whether PTs' technology related knowledge changed after participating into the present study. For the pre- and post-test differences in each sub-scale, *t*-statistics, *p*-values and eta squared measures were calculated. 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 of each sub-scale implied a large effect, with a substantial difference in the technology related subscale scores before and after the intervention. In short, the quantitative phase of the present study showed that the coursework that was specifically designed and that was combined with fieldwork developed PTs' technology related knowledge domains, i.e., TK, TCK, TPK, and TPACK significantly.

For the further analysis of the first research question, six PTs were selected. Based on their mean scores in the TPACK Survey, 22 PTs were divided into three groups as having a low, medium or high level of TPACK and based on their demographic information a total of six PTs were selected from each level, i.e., low, medium and high- two from each.

The data collected from the six cases using a number of data collection tools such as written reflections and interviews throughout the study were analyzed using qualitative content analysis based on TPACK a priori codes. The findings of the qualitative content

analysis revealed that PTs' TPACK developed as they participated into the study. 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. In addition to the percentages, their quotations also revealed their changing understanding of TPACK.

For the second research question, the lesson plans and observational data of the six cases were analyzed using the Technology Integration Observation Instrument, developed by Harris, Grandgenett, and Hofer (2010), in order to see how PTs' TPACK was reflected in their instructional practices. These analyses revealed that both during the planning and implementation processes, PTs considered the relationship among content, pedagogy and technology and worked hard to improve the quality of their lessons by integrating technology effectively.

The findings of the present study are in parallel to the findings of similar studies conducted by Suharwoto (2006), Harrington (2008), Cavirn (2007) and Koehler, Mishra, and Yahya (2007).

In Suharwoto's case study with mathematics PTs, it was found that all the participating PTs showed various degrees of understanding the four components of TPACK after participating into a subject specific, technology integrated one-year long teacher preparation program which combined coursework with fieldwork.

Harrington (2008) also carried out a similar study with five PTs to document the development of their Technology Specific Pedagogy as they learned to teach mathematics with technology during their initial licensure program. Five pre-service teachers were followed during coursework and participation in the Technology Partnership Project field experience. The analysis of the data showed that PTs' TPACK developed at the end of the study.

Similar findings were gathered from the case study of Cavirn (2007) who explored TPACK development of preservice teachers from mathematics and science education majors. For the study, a specific program which incorporated coursework and micro-teaching experience was designed. The findings of the study revealed that there occurred several changes in TPACK as the participants worked through the micro-teaching process. PTs began to adjust technology, content and pedagogy to fit each other.

The findings of the present study were also similar to the findings of the research conducted by Koehler, Mishra, and Yahya (2007). In their study with faculty members and graduate students, Koehler, Mishra and Yahya investigated whether their TPACK developed over time as they participated into a design study. It was found that the participants began to develop an understanding of the interrelationship of the three components.

What is common to all these studies including the present study is the combination of coursework with fieldwork. In relation to the development of TPACK, Niess (2008) discusses that "no matter how marvellous the coursework is in providing them with knowledge about teaching with technology, they must have opportunities to apply this knowledge" (p. 246). Field experiences help PTs to understand the importance of planning and preparation, the value of specific instructional strategies and comprehend the complexities involved in teaching with technology, thus developing their TPACK.

For the purposes of the present study, coursework and fieldwork were combined and certain types of experiences and learnings were planned to bring about the TPACK. The course designed followed learning technology by design approach (Mishra & Koehler, 2006); was based on problem-based learning (Merrill, 2002); incorporated collaborative work (socio-cultural theory); and engaged PTs in reflective practice (Schon, 1983).

Koehler and Mishra suggested that learning by design, when applied to preservice teacher technology education, offers opportunities for teachers to use technology in authentic

problem solving contexts and to explore "the rich connections between technology, the subject matter (content), and the means of teaching it (the pedagogy)" (2005a, p. 95). It was seen in this study that when PTs designed their lesson plans, they considered the connections between content, pedagogy and technology. PTs were assigned a coursebook unit by their cooperating teachers at their practice schools. Their starting point was finding a problem and offering a solution to it using technology. Focusing on a problem helped them to consider three knowledge components in relation to each other so that they could raise the effectiveness of the lesson. Pope, Hare, and Howard (2005) suggest that "preservice teachers need opportunities to learn with the technology by being exposed to authentic, learner-centred activities that allow them to construct their own understanding of the learning outcomes" (p. 574). When learners engage in an activity, the context of the activity becomes part of the knowledge and the problem that learners attempt to solve becomes their problem (Johnasson et al. 1999; Putnam & Borko 2000).

In a number of studies based on learning by design approach, Mishra and Koehler showed that in the process of working through design problems, participants developed TPACK by actually using and designing educational technology to teach specific content. As they discussed, engaging in design work helped teachers move from a divided view of technology, pedagogy and content knowledge to a unified perspective of the ways in which the different types of knowledge overlap. This might be one of the explanations of the development and the increase of PTs' TPACK in the present study.

In learning technology by design approach, teachers are offered little direct instruction on technology but expected to learn about it on their own with the help of their peers (Mishra, Dirkin, & Cavanaugh, 2007). Such an approach helps teachers learn "how to learn" about technology and "how to think about" educational technology as they explore technology while trying to solve educational problems. In the present study, during the treatment, PTs

discovered the technologies themselves and then presented them to their peers. 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. They were asked to discuss how the tool could be used in language teaching and give or suggest one or two examples of its use. This approach helped PTs learn "how to learn" about technologies. The following comments coming from the PTs illustrate this point:

> I am about to become a teacher and now I feel myself to be very competent. I have changed a lot. Now I can solve my problems myself, I know how to learn, I can take responsibilities, I can use a number of new technologies. My friends call me "Ms Technology." I am so enthusiastic now. I want to read and learn more about effective technology integration *(Pınar)*.

> During the process of the study, I learned how to learn. I do not need help from someone else to learn about a new technology. I can explore it myself. Now whenever I see a new technology, I ask myself how it can be used creatively in language teaching *(Gözde)*.

Working collaboratively during the treatment was another factor contributing to the success of the present study in terms of developing PTs' TPACK. Throughout the treatment, PTs collaborated with each other in many cases. They worked together to give presentations of technological tools and they gave feedback to each other's lesson plans. These processes in which PTs worked together or helped each other were noted as the most beneficial by the PTs themselves:

> When I received feedback from my instructor and my peers, I felt relaxed. Everything was all right. The feedback helped me to develop an efficient plan. It made everything

clear in my mind *(Zeynep)*.

I benefited most from the feedback sessions. Taking the opinions of my instructor and peers helped me to reflect on my plan and do some revisions. People cannot see their own mistakes easily. I feel more comfortable about my plan after I receive feedback *(Nil)*.

One of the best parts of this training was the feedback sessions. Working with my instructor and friends helped me a lot. When we worked together, we produced more creative ideas. We became generative in this way. It is a very good idea to share our plans with each other. I feel secure. While preparing my plan, I was not worried. I knew that even if I had done something wrong, I would have received feedback and could modify my plan. This made me feel safe and less stressful *(Pınar)*.

Mishra and Koehler (2006) state that development of TPACK is a developmental process (Mishra &Koehler, 2006) and that pre-service and in-service teachers will exhibit varying degrees of such knowledge. Teachers' stages of learning to teach with technology begin with the mechanical level (or entry), during which teachers follow instructions explicitly and use the technology as the manufacturer or programmer intended. Next, teachers progress to the meaningful level during which they think of or accept alternate ways of using the technology. In the final stage of learning to teach with technology, teachers' practice reflects the generative level in which they move away from traditional uses of technology, take into account their content and are aware of appropriate and inappropriate uses of technology (Zhao, et al. 2006). The developmental nature of TPACK was one of the factors

guiding the course design of the present study. When the technology use of six PTs is considered, it can be said that they are somewhere in between meaningful and generative levels of using technology. Their technology use demonstrated that they could think of alternate ways of using the technology by taking their content into account. However, their original plans before the feedback session was not at a generative level. They needed some suggestions from their peers and the instructor. This can be attributed to PTs' lack of experience in planning and presenting a lesson.

The findings of the present study also have some significant theoretical implications regarding the construct of TPACK. Two epistemological views, integrative and transformative, exist in the current literature to explore the TPACK construct. While the integrative views emphasizes the relationship between the three knowledge domains (C, P, T) and their intersections (PCK, TCK, TPK) and argues that TPACK develops from those knowledge bases, the transformative view considers TPACK as a unique body of knowledge (Angeli and Valanides, 2005; Graham, 2011). It is argued by Angeli and Valanides that whether TPACK is a distinct body of knowledge (transformative perspective) or growth in TPACK means growth in any of its constructs (integrative perspective) is not clear from the empirical findings available in the relevant literature, thus needs further theoretical clarity. In their conceptualization of TPACK, Angeli and Valanides (2008) claim that "TPCK is a distinct or unique body of knowledge that is constructed from the dynamic interaction of its constituent knowledge bases namely knowledge of content, pedagogy, learners, context, and technology" (p. 19). They have carried out a number of studies with both in-service and pre-service teachers to test the hypothesis that growth in TPCK simply means growth in any of the related constructs (i.e., Pedagogical Content Knowledge, Technological Content Knowledge, Technological Pedagogical Knowledge). In a number of studies, Angeli and Valanides (2005, 2008) compared in-service teachers who did not receive any TPACK

training but had high teaching experience and with the teachers who also had no TPACK training but had less teaching experience in terms of their performance on technology design tasks and did not find a significant difference between the groups. When the groups received training on TPACK, teachers with more teaching experience performed better then the less experienced ones. In their similar study with pre-service teachers, they found that the TPACK training that pre-service teachers received affected their performance in designing learning activities with technology. It was concluded by Angeli and Valadines that in-service and pre-service teachers need to be explicitly taught how a particular technological tool can be used to teach specific content to a group of specific learners. In other words, the interactions among technology, pedagogy, content and learners should be emphasized. They add that "knowledge and growth in each constituent knowledge base, such as content, pedagogy, learners, and technology, per se, without any specific instruction targeting exclusively TPCK as a unique body of knowledge, does not imply automatic growth in TPCK" (2008, p. 13).

The present study provided evidence for the construct of TPACK as a distinct body of knowledge. By looking for evidence of each seven TPACK construct (CK, TK, PK, PCK, TCK, TPK and TPACK), the present study found that the development of TPACK was independent from the changes in the other constructs throughout the study. For example, Pınar's data showed that at the beginning of the study there was no evidence of CK, TCK or TPACK in her reflections, little evidence for TK, PCK and TCK (3.8 %, 8.9 %, 10 % respectively) and a very strong evidence for PK (73.1 %). As the study progressed, the most significant finding was the increase in the TPACK (0% to 25.7%) and the decrease in the PK (73.1% to 10.2 %). At the end of the study, while TPACK increased at a great extent (75.8%), PK could hardly be observed (2%). In other words, Pınar moved from thinking content, pedagogy, technology and their combinations (PCK, TCK, TPK) separately to a more complete and sophisticated level of thinking, TPACK. Similar results were obtained from

Gözde, Zeynep, Nil, Özlem and Hande. While at the beginning of the study Gözde's comments were dominated by pedagogy (63%) and pedagogy and content (28.8%), as the study progressed, her comments reflected her increased understanding of the relationship between content, pedagogy and technology (TPACK: 23.7% during the study; 70.3% at the end of the study). Zeynep's data revealed that TPK was the dominating knowledge base reflected in her comments at the beginning and end of the study (51.1% and 39.6%, respectively). While her TPACK developed to some extent (from 0% to 18.5%) at the end of the study, her TPK was still the most reflected. Nil's data showed that her TPACK improved significantly as she received the explicit training of TPACK (from 0% to 63%) while less evidence of the other knowledge components could be found in her data as the study progressed (e.g., TPK, from 85.2% to 30.4%). Özlem's data also revealed that she began the study with a high understanding of the relationship between pedagogy and technology (TPK, 41.9%) and between content, pedagogy and technology (TPACK, 42.1%). During the study, the majority of her comments continued to reflect her TPK (20.6%) and TPACK (23.1%). At the end of the study, TPACK was evident in the majority of her comments (68.7%) while the instances of her TPK dropped dramatically (6.6%). Finally, Hande's data showed that she had a deep understanding of the relationship between content, pedagogy and technology (TPACK) at the beginning (65.4%), during (39.1%) and at the end of the study (80.4%). The analysis of her data reflected that her TPACK development was independent from the development of the other knowledge bases in the TPACK framework.

In short, these findings provided some empirical data for the discussion on "whether TPCK is a distinct form of knowledge or whether growth in TPCK simply means growth in any of the related constructs " (Angeli & Valanides, 2009, p. 157) supporting the view of TPACK as a district construct. The findings of the present study suggest that TPACK can be considered as a unique body of knowledge. PTs in the present study moved from having more

fragmented idea units (CK, PK, TK, PCK and so on), to larger and more coherent idea units (TPACK) after receiving explicit training on the construct of TPACK.

To summarize, the present study focused on PTs' development of TPACK by designing problem-centred tasks, developing skills using learning technology by design approach, encouraging collaborative learning and engaging PTs in reflective practice. The findings coming from the quantitative data showed that all participating PTs' (N= 22) TPACK level increased at a significant level at the end of the study. The qualitative data coming from the six cases chosen among those 22 PTs supported these findings and revealed that, as the study progressed, PTs' began to consider technology in relation to content and pedagogy. Moreover, their TPACK was reflected in their teaching practice.

5.1. Implications of the study

Based on the findings, the present study has several implications for teacher education programs: First of all, teacher education programs should offer PTs with courses teaching technology in contexts that focus on the relationship among technology, content and pedagogy. During their teacher education program, most PTs are offered technology-specific courses to develop their basic computer skills, such as word processors, email, basic web development, and Internet searches (Hargrave & Hsu, 2000). However research indicated that that these stand-alone courses do not prepare teachers to use technology in a variety of instructional settings as they lack exposure to appropriate models of computer use in content-area specific classroom settings (Mehlinger & Powers, 2002). Similarly, Hughes and Scharber (2008) discuss that technology learning focused on a specific subject matter can yield content specific technology integration in the classroom. Thus, as the present study did, the 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 matter.

Another implication is that 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 and practicing teachers, if they use technology at all, tend to use it in superficial, low-level ways (Doering & Veletsianos, 2008). The resultant absence of meaningful technology integration in classrooms lead to a deep disconnect between the current generation of students who have spent their formative years immersed in technology (digital natives), and their teachers (digital immigrants) whose experience with and knowledge of the digitized world may be underdeveloped (Prensky, 2001). Thus, PTs should be given the opportunity to apply the theoretical knowledge they gain in the coursebook in their practicum practice.

Niess (2008) discusses that "technology integration needs to be directed toward the development of the strategic thinking of TPCK so that preservice teachers are prepared to actively consider when, where, and how technology might enhance student learning" (p. 249). She adds that for strategic thinking, PTs should learn how to monitor their own progress in the development of their TPACK through reflection. The reflection is seen as an important experience for the 21st century teacher who has got the knowledge of the intersection of content, technology and pedagogy. In the present study, PTs were asked to reflect on the every experience they had throughout the program. Reflecting on their lesson plans and lesson plan implementations made them aware of their own development of TPACK. Their talks reflected that their attention was explicitly focused on the intersection of content, technology and pedagogy. Thus, courses on technology integration in the teacher education departments

should incorporate reflection as part of their practice to educate PTs as the future teachers with the knowledge and skills for teaching effectively with technology.

Throughout the present study, PTs of English worked as "designers." They created technology integrated lesson plans in their subject area, i.e., English language teaching, 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 the 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 present study has got some implications for the Turkish setting. Turkey has been implementing major reforms in education since the 1970s in order to become a more developed country and a member of the European Union. These reforms in education have been initiated by the Turkish Ministry of National Education, which controls the public and private educational institutions except for universities. One of the major reforms in the Turkish educational system was the extension of five-year compulsory education to eight-year education in 1997 with funding provided by the World Bank (Akkoyunlu, 2010). The general objectives of this reform, specifically called the Basic Education Programme, were "to spread compulsory education nationwide, to increase the quality of primary education and to provide schools with learning centres" (Akkoyunlu, 2010, p. 168). Some principles such as increasing the schooling rate, equipping teachers and students with computer skills, helping students learn a foreign language, etc. have been set for the application of an eight year compulsory primary education. In relation to technology, the following actions were decided: information technology classrooms would be established in 15 000 schools in Turkey; 200 educational

personnel would be trained to be computer literate, and to train them on computer-based education.

Since the introduction of the compulsory eight-year education law, the Ministry of Education has established almost 3000 computer labs in 2481 primary and secondary schools in every city of Turkey. It was also planned that Internet connections in 2500 primary and secondary schools would be established in order to connect classrooms to the world. The technology policy of The Turkish Ministry of National Education is "to meet the national need for catching up with the age of technology" (Akkoyunlu, 2010, 170). In such a context, educating PTs in order to help them use educational technologies and integrate them into the teaching and learning process effectively in this age of technology becomes essential.

5.2. Suggestions for further research

An important limitation of the study was the lack of generalizability. The sample size was small due to the capacity of the computer laboratory at the research site and limited to a group of PTs from the same public university, thus the sample may not have been necessarily representative of any larger population of PTs. However, as the study aimed to describe TPACK development of a group of PTs who was exposed to a unique, content-specific program based on effective technology integration, findings reveal insights into the program as a model and its structure which might be useful for the development of courses in the English Language Teaching Departments of teacher education programmes.

Another limitation of the study was the lack of investigation into the effects of PTs' technology integrated lessons on students' learning. Further research might focus on measuring the impact of technology integrated lessons on students' learning and their attitudes towards learning English.

"Context" was another limitation in the present study. The schools where PTs completed their practicum had classrooms that did not offer many technological facilities such as Internet or computers for students. This lack of technology limited PTs in their choices of technology and in their creativity. Although they sometimes had more creative ideas and had innovative use of certain technologies devices in mind, they could not apply them due to this problem. Thus, further research can be conducted with PTs who do their practicum at schools equipped with more varied technological devices.

There was also a limitation about the instrument used to collect the quantitative data. The Survey of Pre-service Teachers' Knowledge of Teaching and Technology (Schmidt, et al., 2009) was adapted to the content area of foreign/second language teaching as it originally covered the areas of social studies, mathematics, science and literacy. However, no expert opinion was received on the adapted version of the survey.

Finally, as the PTs of the present study might begin work in different cities in Turkey, it would be difficult to carry out further research with them but contact with some of them can be maintained to see the long-term effects of the training in a new school context.

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APPENDICES

APPENDIX A

AN INVITATION FORM

Dear Students,

The next term, I will be conducting a study for my doctoral dissertation titled as "Developing Technological Pedagogical Content Knowledge of pre-service teachers of English through a design study."

For this study, I want to work with senior year students. The aim of the study is to equip pre-service teachers of English with a specific type of knowledge for effective technology integration. The study will last 12 weeks and we will be meeting for three hours weekly. Twenty to 25 pre-service teachers are needed for the study. The participation is strictly voluntary and will not affect the scores of any courses you take in the second term. Data collected will be done confidentially, and the results will be shared with you at the end of the study. If you are willing to participate, please fill in the form below.

Thank you.

Instructor: Gökçe Kurt

I am willing to participate in this study: Yes No

If Yes,

Name/Surname: Class: E-mail:

Phone:

About your practicum school:

The name of your school:

Technological facilities at your schools (Please circle the ones matching your situation):

1. There is a projector in the classroom. Yes No

2. There is a computer in the classroom. Yes No

3. There is a computer and projector in the classroom. Yes No

4. There is Internet in the classroom.	Yes	No
5. There is a portable CD player.	Yes	No
6. There is a portable OHP in the classrrom/at school.	Yes	No

Other……
……

APPENDIX B

INFORMED CONSENT FORM

Title of Study: Developing Technological Pedagogical Content Knowledge of pre-service teachers of English through a design study.

The Researcher: Gökçe Kurt

Information: Dear Students, you were asked to take part in a research study and you agreed to participate. Your participation in this study is voluntary. You have the right to stop participating at any time. The purpose of this study is to investigate how a specifically designed coursework combined with fieldwork develops pre-service teachers' Technological Pedagogical Content Knowledge. You may benefit from this study by gaining skills in classroom technology integration and developing your Technological Pedagogical Content Knowledge. Throughout the study, a large amount of data will be collected from you. Data collection and analysis procedures will be conducted confidentially and pseudonyms will be used in the dissertation not to reveal your identities.

If you have questions about the study or the procedures, you may contact the researcher, Gökçe Kurt at gokcekurt@marmara.edu.tr .

"I have read and understood the information about the study. By signing this form, I acknowledge and agree to the terms with participating in this study."

Subject's signature_____ Date _____

APPENDIX C

LESSON PLAN FORMAT

<table>
<tr><td colspan="5">LESSON PLAN</td></tr>
<tr><td rowspan="12">PART ONE</td><td colspan="2">Teacher’s Name:</td><td colspan="2">Class(es):</td></tr>
<tr><td colspan="2">Lesson Name:</td><td colspan="2">Date:</td></tr>
<tr><td colspan="2">Book Name:</td><td colspan="2">Duration:</td></tr>
<tr><td colspan="2">Unit Name & Number:</td><td colspan="2">Unit Topic:</td></tr>
<tr><td rowspan="4">Objectives of the lesson</td><td>Grammatical:</td><td colspan="2"></td></tr>
<tr><td>Lexical:</td><td colspan="2"></td></tr>
<tr><td>Skills:</td><td colspan="2"></td></tr>
<tr><td>(Expected) Outcomes/ Behaviours:</td><td colspan="2"></td></tr>
<tr><td colspan="2">Unit Concepts:</td><td colspan="2"></td></tr>
<tr><td colspan="2">Anticipated Problems:</td><td colspan="2"></td></tr>
<tr><td colspan="2">Presumed Knowledge:</td><td colspan="2"></td></tr>
<tr><td colspan="2">Possible Solutions:</td><td colspan="2"></td></tr>
<tr><td colspan="2">Technological Devices:</td><td colspan="2"></td></tr>
<tr><td colspan="2">Student Resources:</td><td colspan="2"></td></tr>
<tr><td colspan="2">Teacher Resources:</td><td colspan="2"></td></tr>
<tr><td rowspan="6">PART TWO</td><td rowspan="6">PROCESS</td><td>Time</td><td colspan="2"></td></tr>
<tr><td rowspan="3"></td><td colspan="2">Grammatical:</td></tr>
<tr><td colspan="2">Lexical:</td></tr>
<tr><td colspan="2">Skills:</td></tr>
<tr><td>P R O C E D U R E

ONE</td><td colspan="2"></td></tr>
<tr><td>Techniques</td><td colspan="2"></td></tr>
<tr><td>Expected Behaviours</td><td colspan="2"></td></tr>
</table>

PART TWO	**PROCESS**	**Time**	
			Grammatical:
			Lexical:
			Skills:
		P R O C E D U R E TWO	
		Techniques	
		Expected Behaviours	
PART TWO	**PROCESS**	**Time**	
			Grammatical:
			Lexical:
			Skills:
		P R O C E D U R E THREE	
		Techniques	
		Expected Behaviours	

PART TWO	**PROCESS**	**Time**	
			Grammatical:
			Lexical:
			Skills:
		P R O C E D U R E **FOUR**	
		Techniques	
		Expected Behaviours	
PART TWO	**PROCESS**	**Time**	
			Grammatical:
			Lexical:
			Skills:
		P R O C E D U R E **FIVE**	
		Techniques	
		Expected Behaviours	

PARTWO	**PROCESS**	**Time**	
			Grammatical:
			Lexical:
			Skills:
		P R O C E D U R E SIX	
		Techniques	
		Expected Behaviours	
PARTWO	**PROCESS**	**Time**	
			Grammatical:
			Lexical:
			Skills:
		P R O C E D U R E SEVEN	
		Techniques	
		Expected Behaviours	

PART THREE	**Assessment & Evaluation**	**Individual:** **Group:**
PART FOUR	**Possible Problems and Solutions Related to the Application of the Plan**	**Possible problems:** **Possible Solutions:**

APPENDIX D

THE CASE

Case Vignette. Mr. Jorgensen, an eighth grade history teacher, hears about a technology called a *weblog* and learns how to create one. He reflects on how weblogs could impact history and realizes that, if a lot of people keep weblogs, we could have numerous first-hand accounts of events, taking history out of the ivory tower and putting it in the voices of the individuals who lived it. He searches the Internet for weblogs by people in Israel, Iraq, China, New Orleans, and other places that are of current importance, and is amazed at the powerful first-hand accounts of current events he finds on those blogs. Mr. Jorgensen thinks about how he could use weblogs with his students. He realizes that he could keep one for his classes with assignments, calendars, and other classroom management items. He could also have his students keep their own blogs to improve their writing and reflection and to motivate them to complete more professional work. After testing out the class blog, Mr. Jorgensen decides to use weblogs to help his students understand that history is happening all around them and to help them see their place in it. They begin by reading a historian's account of an event, then a first person account of the same event. They talk about the difference in impact of the two. Then they search the Internet for weblogs written by students their age in other parts of the world that are currently playing a large role in world affairs. The students then create their own weblogs which they use to write about what's going on in the world around them, including direct links to and reflections about what the students whose blogs they are reading are going through. He is impressed by his students' progress in understanding and reflecting on world events.

(Cox & Graham, 2009).

APPENDIX E

SURVEY OF PRE-SERVICE TEACHERS' KNOWLEDGE OF TEACHING AND TECHNOLOGY

Technology is a broad concept that can mean a lot of different things. For the purpose of this questionnaire, ***technology*** *is referring to digital technology/technologies. That is, the digital tools we use such as computers, laptops, iPods, handhelds, interactive whiteboards, software programs, etc. Please answer all of the questions and if you are uncertain of or neutral about your response you may always select "Neither Agree or Disagree"*

1= Strongly Disagree 2= Disagree 3= Neither Agree or Disagree 4= Agree 5= Strongly Agree

TK (Technology Knowledge)

1. I know how to solve my own technical problems.	1	2	3	4	5
2. I can learn technology easily.	1	2	3	4	5
3. I keep up with important new technologies.	1	2	3	4	5
4. I frequently play around with the technology.	1	2	3	4	5
5. I know about a lot of different technologies.	1	2	3	4	5
6. I have the technical skills I need to use technology.	1	2	3	4	5
7. I have had sufficient opportunities to work with different technologies.	1	2	3	4	5

CK (Content Knowledge)

Mathematics

8. I have sufficient knowledge about mathematics	1	2	3	4	5
9. I can use an mathemtaical way of thinking	1	2	3	4	5
10. I have various ways and strategies of developing my understanding of mathematics.	1	2	3	4	5

Social Studies

11. I have sufficient knowledge about social studies.	1	2	3	4	5
12. I can use a historical way of thinking.	1	2	3	4	5
13. I have various ways and strategies of developing my understanding of social studies.	1	2	3	4	5

Science

14. I have sufficient knowledge about science.	1	2	3	4	5
15. I can use a scientific way of thinking.	1	2	3	4	5
16. I have various ways and strategies of developing my understanding of science.	1	2	3	4	5

Literacy

17. I have sufficient knowledge about literacy.	1	2	3	4	5
18. I can use a literary way of thinking.	1	2	3	4	5
19. I have various ways and strategies of developing my understanding of literacy.	1	2	3	4	5

PK (Pedagogical Knowledge)

20. I know how to assess student performance in a classroom.	1	2	3	4	5
21. I can adapt my teaching based-upon what students currently understand or do not understand.	1	2	3	4	5

22. I can adapt my teaching style to different learners.	1	2	3	4	5
23. I can assess student learning in multiple ways.	1	2	3	4	5
24. I can use a wide range of teaching approaches in a classroom setting (collaborative learning, direct instruction, inquiry learning, problem/project based learning etc.).	1	2	3	4	5
25. I am familiar with common student understandings and misconceptions.	1	2	3	4	5
26. I know how to organize and maintain classroom management.	1	2	3	4	5

PCK (Pedagogical Content Knowledge)

27. I know how to select effective teaching approaches to guide student thinking and learning in mathematics.	1	2	3	4	5
28. I know how to select effective teaching approaches to guide student thinking and learning in literacy.	1	2	3	4	5
29. I know how to select effective teaching approaches to guide student thinking and learning in science.	1	2	3	4	5
30. I know how to select effective teaching approaches to guide student thinking and learning in social studies.	1	2	3	4	5

TCK (Technological Content Knowledge)

31. I know about technologies that I can use for learning about and doing mathematics.	1	2	3	4	5
32. I know about technologies that I can use for learning about and doing literacy.	1	2	3	4	5
33. I know about technologies that I can use for learning about and doing science.	1	2	3	4	5
34. I know about technologies that I can use for learning about and doing social studies.	1	2	3	4	5

TPK (Technological Pedagogical Knowledge)

35. I can choose technologies that enhance the teaching approaches for a lesson.	1	2	3	4	5
36. I can choose technologies that enhance students' learning for a lesson.	1	2	3	4	5
37. My teacher education program has caused me to think more deeply about how technology could influence the teaching approaches I use in my classroom.	1	2	3	4	5
38. I am thinking critically about how to use technology in my classroom.	1	2	3	4	5
39. I can adapt the use of the technologies that I am learning about to different teaching activities.	1	2	3	4	5

TPACK (Technology Pedagogy and Content Knowledge)

40. I can teach lessons that appropriately combine mathematics, technologies and teaching approaches.	1	2	3	4	5
41. I can teach lessons that appropriately combine literacy, technologies and teaching approaches.	1	2	3	4	5
42. I can teach lessons that appropriately combine science, technologies and teaching approaches.	1	2	3	4	5
43. I can teach lessons that appropriately combine social	1	2	3	4	5

studies, technologies and teaching approaches.	
44. I can select technologies to use in my classroom that enhance what I teach, how I teach and what students learn.	1 2 3 4 5
45. I can use strategies that combine content, technologies and teaching approaches that I learned about in my coursework in my classroom.	1 2 3 4 5
46. I can provide leadership in helping others to coordinate the use of content, technologies and teaching approaches at my school and/or district.	1 2 3 4 5
47. I can choose technologies that enhance the content for a lesson.	1 2 3 4 5

Models of TPACK (Faculty, PreK-6 teachers)

48. My mathematics education professors appropriately model combining content, technologies and teaching approaches in their teaching.	1 2 3 4 5
49. My literacy education professors appropriately model combining content, technologies and teaching approaches in their teaching.	1 2 3 4 5
50. My science education professors appropriately model combining content, technologies and teaching approaches in their teaching.	1 2 3 4 5
51. My social studies education professors appropriately model combining content, technologies and teaching approaches in their teaching.	1 2 3 4 5
52. My instructional technology professors appropriately model combining content, technologies and teaching approaches in their teaching.	1 2 3 4 5
53. My educational foundation professors appropriately model combining content, technologies and teaching approaches in their teaching.	1 2 3 4 5
54. My professors outside of education appropriately model combining content, technologies and teaching approaches in their teaching.	1 2 3 4 5
55. My PreK-6 cooperating teachers appropriately model combining content, technologies and teaching approaches in their teaching.	1 2 3 4 5
56. In general, approximately what percentage of your teacher education professors provided an effective model of combining content, technologies and teaching approaches in their teaching?	0% ____ 25% or less ___ 26% - 50% ___ 51% - 75% ___ 76%-100% ___
57. In general, approximately what percentage of your professors outside of teacher education have provided an effective model of combining content, technologies and teaching approaches in their teaching?	0% ____ 25% or less ___ 26% - 50% ___ 51% - 75% ___ 76%-100% ___
58. In general, approximately what percentage of the PreK-6 cooperating teachers have provided an effective model of combining content, technologies and teaching approaches in their teaching?	0% ____ 25% or less ___ 26% - 50% ___ 51% - 75% ___ 76%-100% ___

Please complete this section by writing your responses in the boxes.

59. Describe a specific episode where an ISU professor or instructor effectively demonstrated or modelled combining content, technologies and teaching approaches in a classroom lesson. Please include in your description what content was being taught, what technology was used, and what teaching approach(es) was implemented.

60. Describe a specific episode where one of your PreK-6 cooperating teachers effectively demonstrated or modelled combining content, technologies and teaching approaches in a classroom lesson. Please include in your description what content was being taught, what technology was used, and what teaching approach(es) was implemented. If you have not observed a teacher modelling this, please indicate that you have not.

61. Describe a specific episode where you effectively demonstrated or modelled combining content, technologies and teaching approaches in a classroom lesson. Please include in your description what content you taught, what technology you used, and what teaching approach(es) you implemented. If you have not had the opportunity to teach a lesson, please indicate that you have not.

APPENDIX F

SURVEY OF PRE-SERVICE TEACHERS' KNOWLEDGE OF TEACHING AND TECHNOLOGY

(Adapted Version)

Technology is a broad concept that can mean a lot of different things. For the purpose of this questionnaire, ***technology*** *is referring to digital technology/technologies. That is, the digital tools we use such as computers, laptops, iPods, handhelds, interactive whiteboards, software programs, etc. Please answer all of the questions and if you are uncertain of or neutral about your response you may always select "Neither Agree or Disagree"*

1= Strongly Disagree 2= Disagree 3= Neither Agree or Disagree 4= Agree 5= Strongly Agree

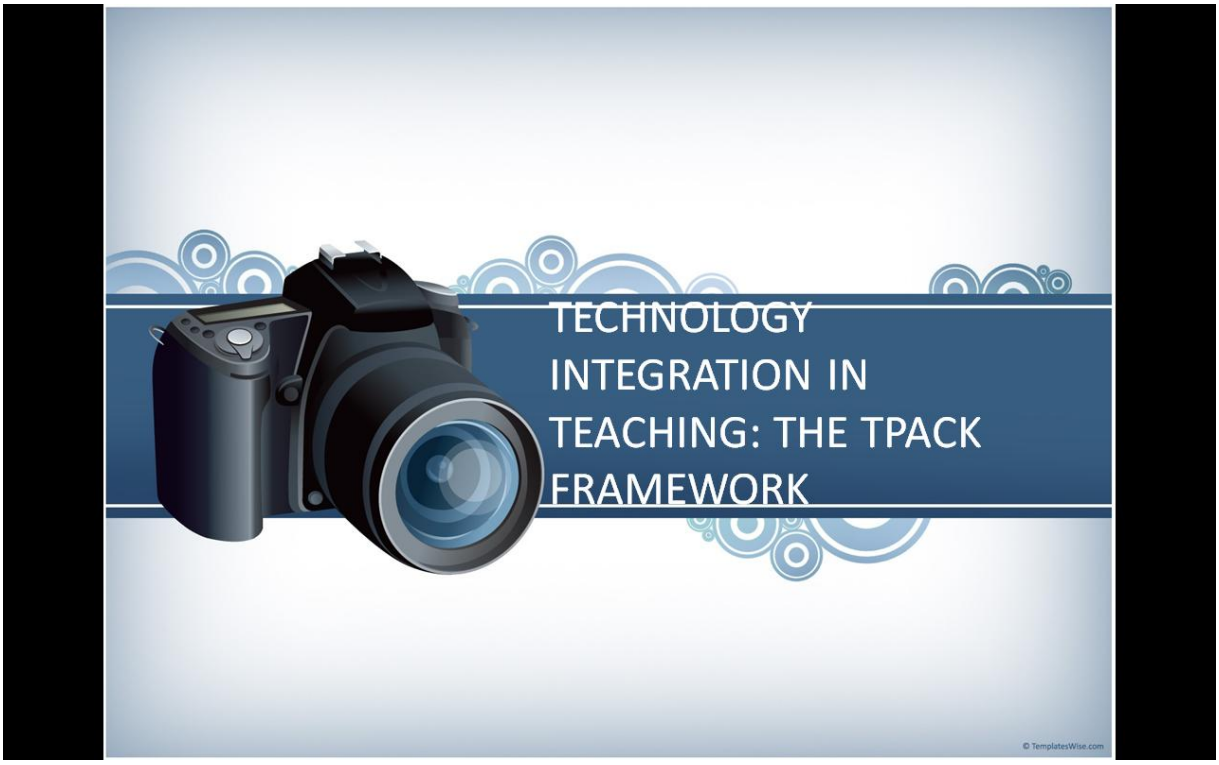
1. I know how to solve my own technical problems.	1	2	3	4	5
2. I can learn technology easily.	1	2	3	4	5
3. I keep up with important new technologies.	1	2	3	4	5
4. I frequently play around with the technology.	1	2	3	4	5
5. I know about a lot of different technologies.	1	2	3	4	5
6. I have the technical skills I need to use technology.	1	2	3	4	5
7. I have had sufficient opportunities to work with different technologies.	1	2	3	4	5
8. I have sufficient knowledge about English (in general)	1	2	3	4	5
9. I can use an English way of thinking	1	2	3	4	5
10. I have various ways and strategies of developing my understanding of English.	1	2	3	4	5
11. I know how to assess student performance in a classroom.	1	2	3	4	5
12. I can adapt my teaching based-upon what students currently understand or do not understand.	1	2	3	4	5
13. I can adapt my teaching style to different learners.	1	2	3	4	5
14. I can assess student learning in multiple ways.	1	2	3	4	5
15. I can use a wide range of teaching approaches in a classroom setting (collaborative learning, direct instruction, inquiry learning, problem/project based learning etc.).	1	2	3	4	5

16. I am familiar with common student understandings and misconceptions.	1	2	3	4	5
17. I know how to organize and maintain classroom management.	1	2	3	4	5
18. I know how to select effective teaching approaches to guide student thinking and learning in English	1	2	3	4	5
19. I know about technologies that I can use for learning about and using English.	1	2	3	4	5
20. I can choose technologies that enhance the teaching approaches for a lesson.	1	2	3	4	5
21. I can choose technologies that enhance students' learning for a lesson.	1	2	3	4	5
22. My teacher education program has caused me to think more deeply about how technology could influence the teaching approaches I use in my classroom.	1	2	3	4	5
23. I am thinking critically about how to use technology in my classroom.	1	2	3	4	5
24. I can adapt the use of the technologies that I am learning about to different teaching activities.	1	2	3	4	5
25. I can teach lessons that appropriately combine English, technologies and teaching approaches.	1	2	3	4	5
26. I can select technologies to use in my classroom that enhance what I teach, how I teach and what students learn.	1	2	3	4	5
27. I can use strategies that combine content, technologies and teaching approaches that I learned about in my coursework in my classroom.	1	2	3	4	5
28. I can provide guidance in helping others to coordinate the use of content, technologies and teaching approaches at my school.	1	2	3	4	5
29. I can choose technologies that enhance the content for a lesson.	1	2	3	4	5

APPENDIX G

THE SLIDES

Slide 1:



Slide 2:

Technology

Picture taken from http://punya.educ.msu.edu/

Slide 3:

- So what are teachers to do??

Slide 4:

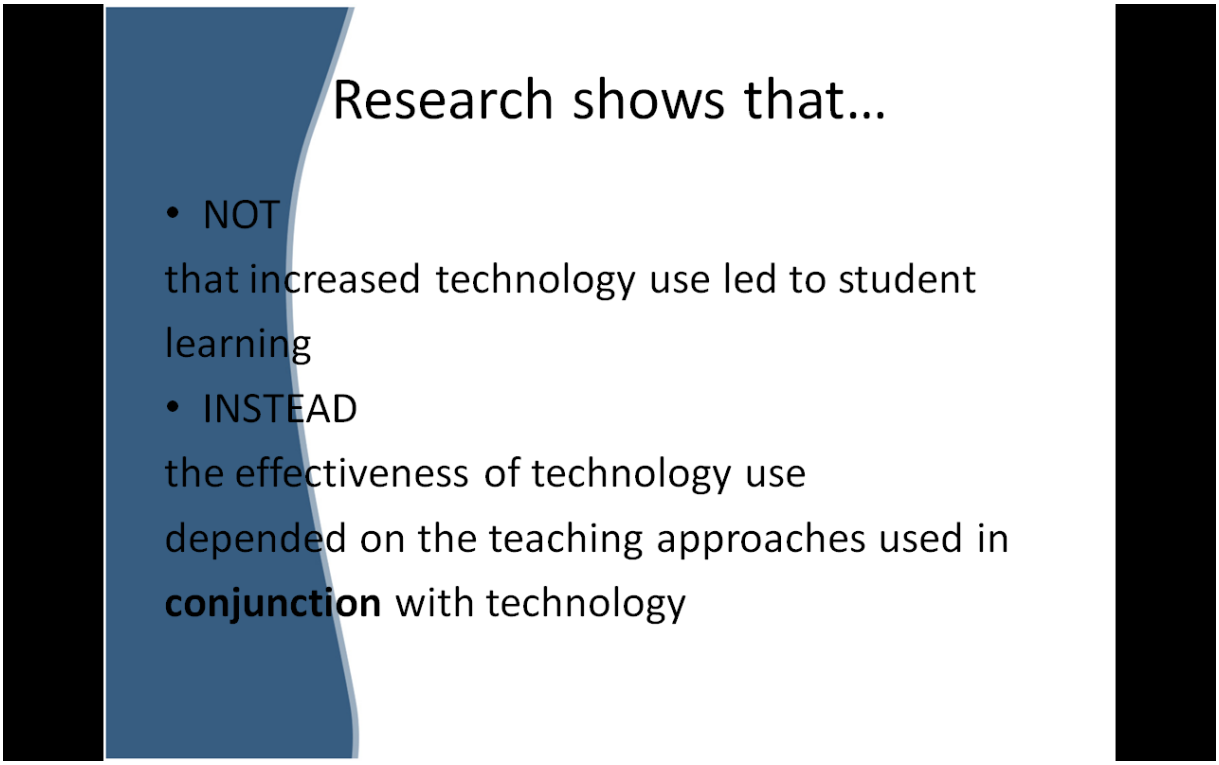
- Rather than focusing on particular technologies, it becomes more important to think about ways of thinking in this world (Mishra&Koehler, 2010).

Slide 5:

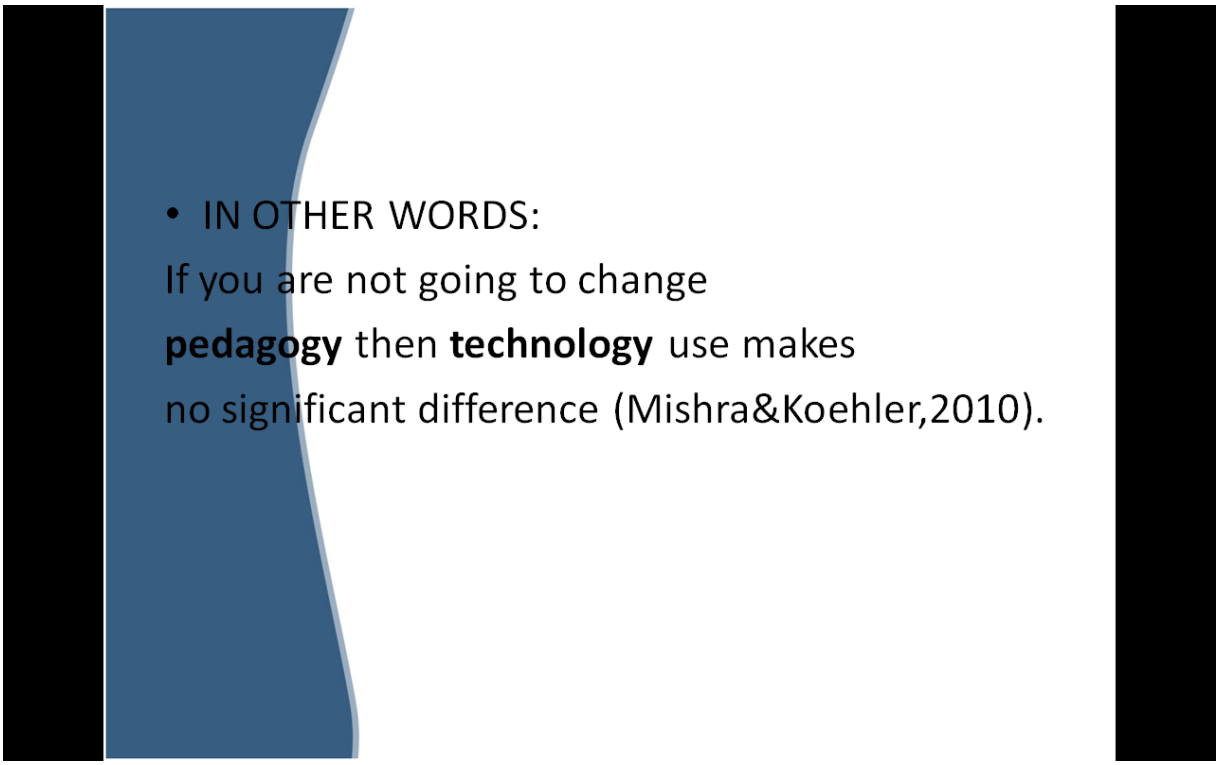
- How are teachers using Technology?

Slide 6:

Slide 7:



Slide 8:



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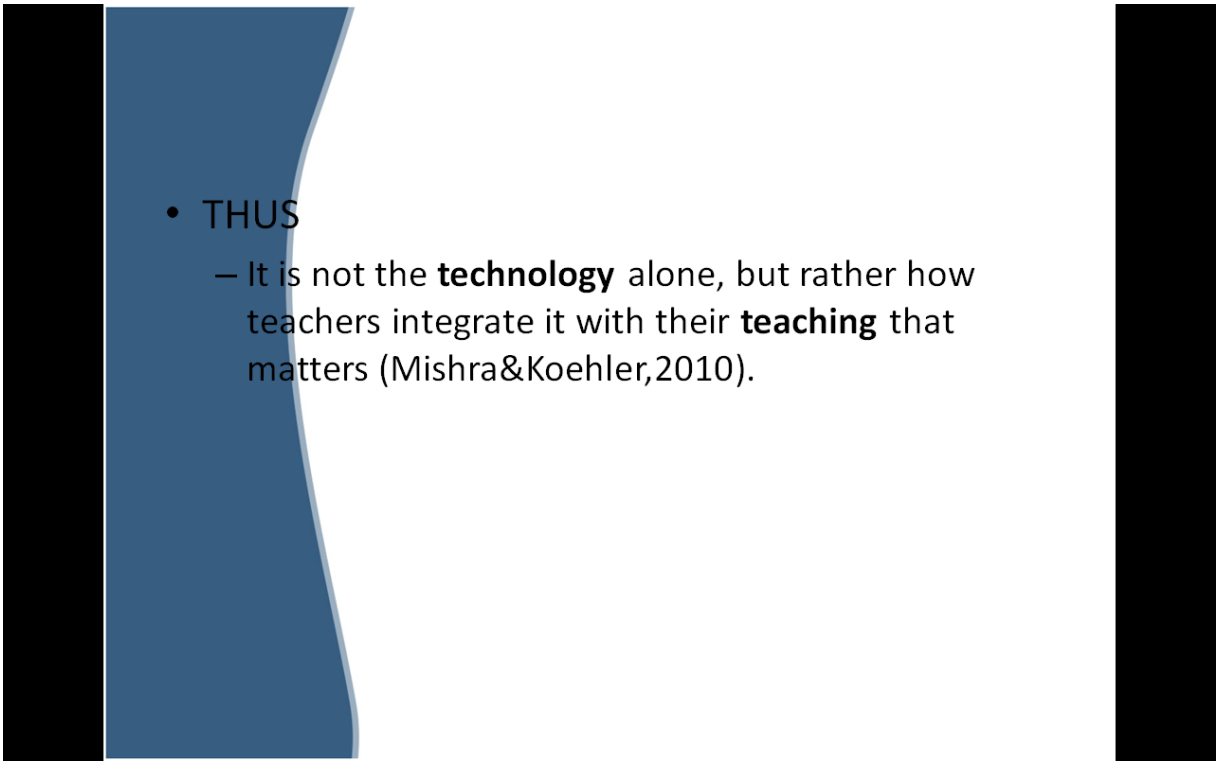

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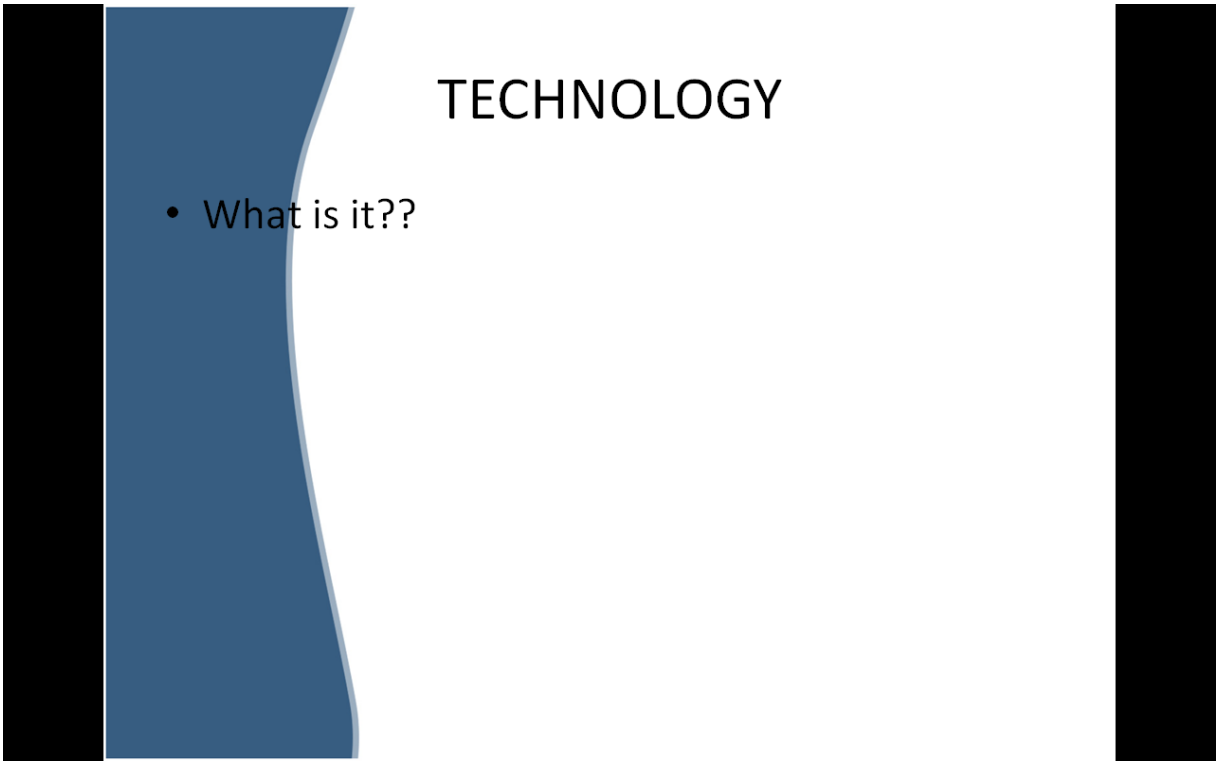
Slide 11:



Slide 12:

TECHNOLOGY

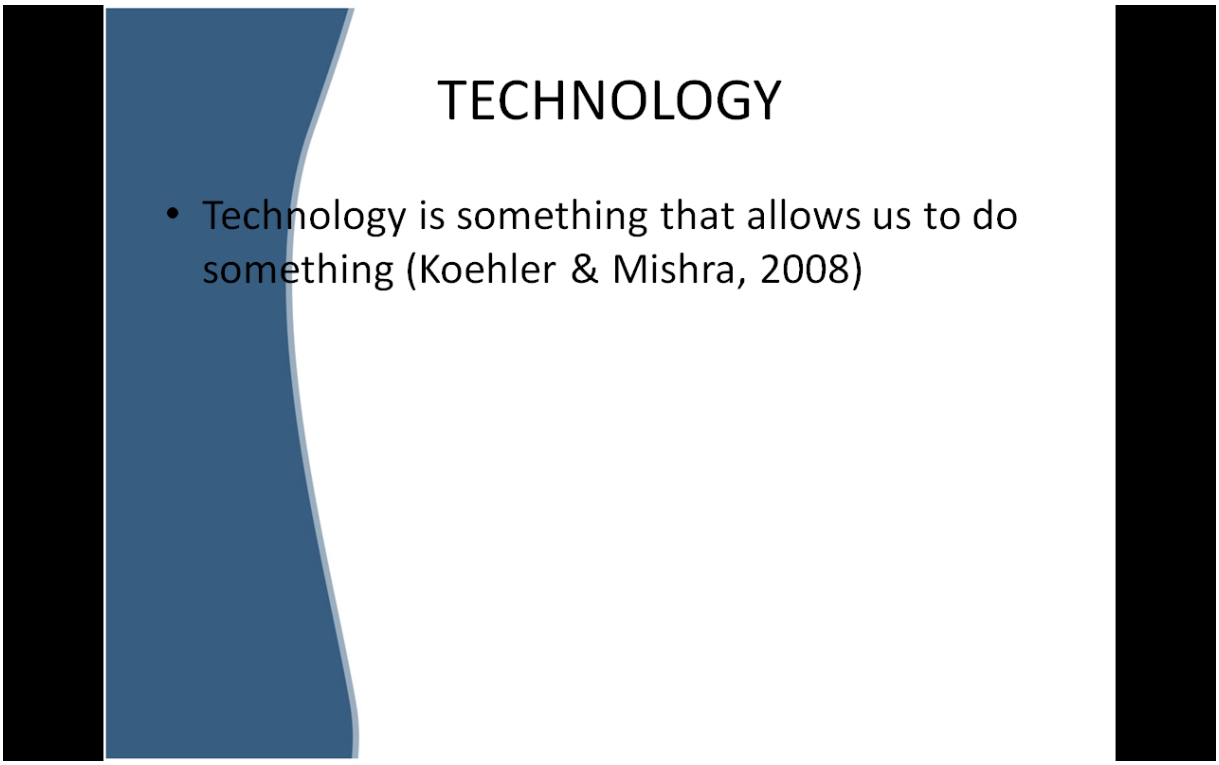
- Digital vs Analog
- New vs Old

Slide 13:

TECHNOLOGY

Picture taken from http://punya.educ.msu.edu/

Slide 14:



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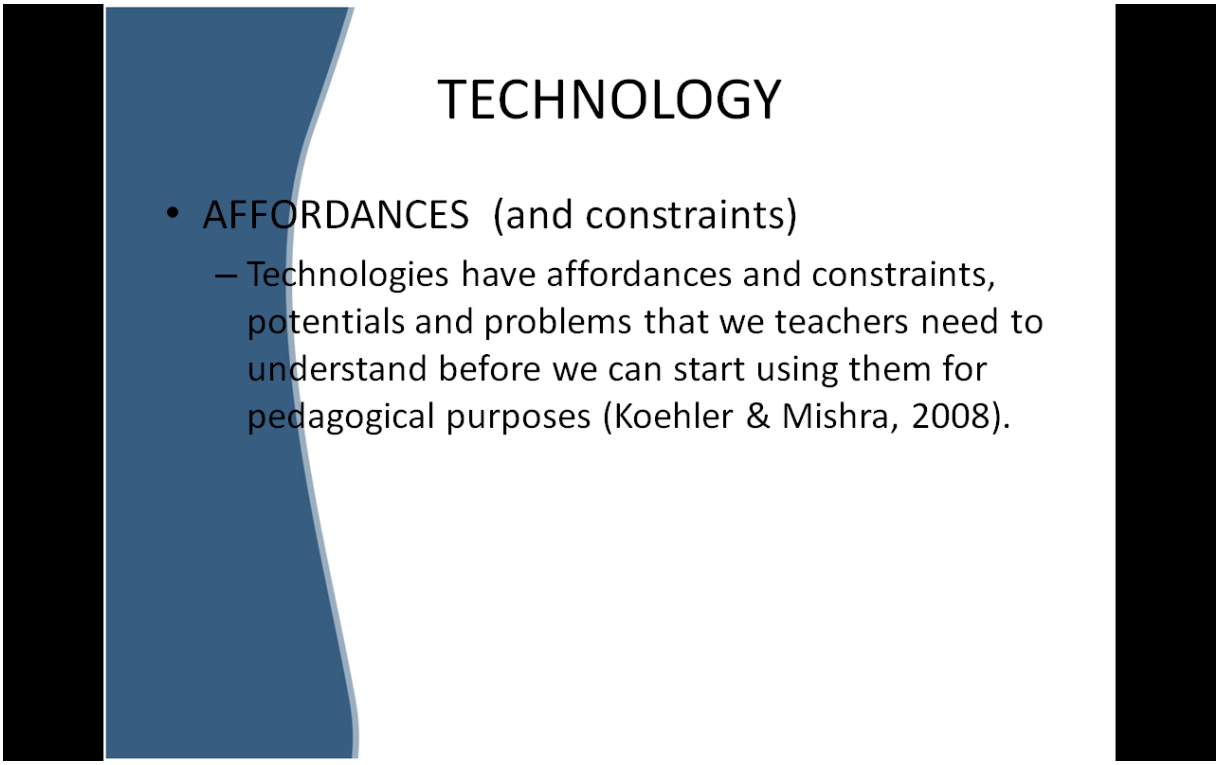

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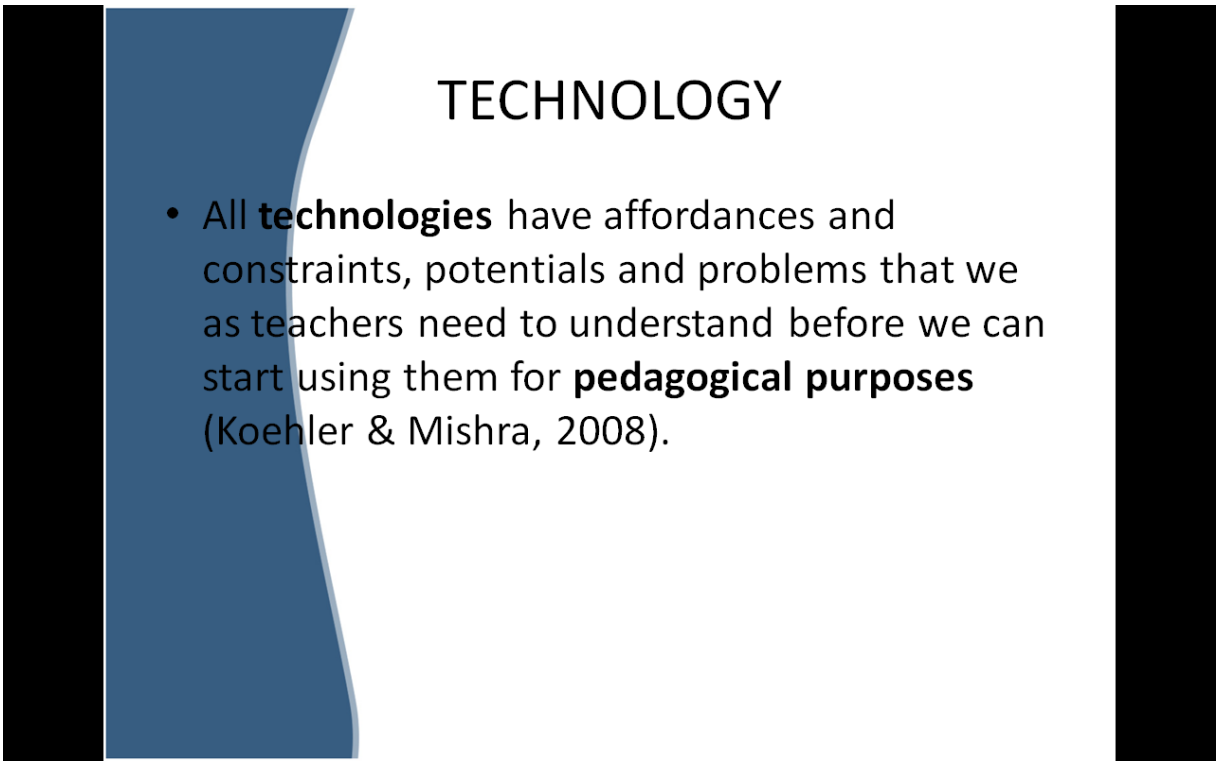


Slide 19:

Slide 20:

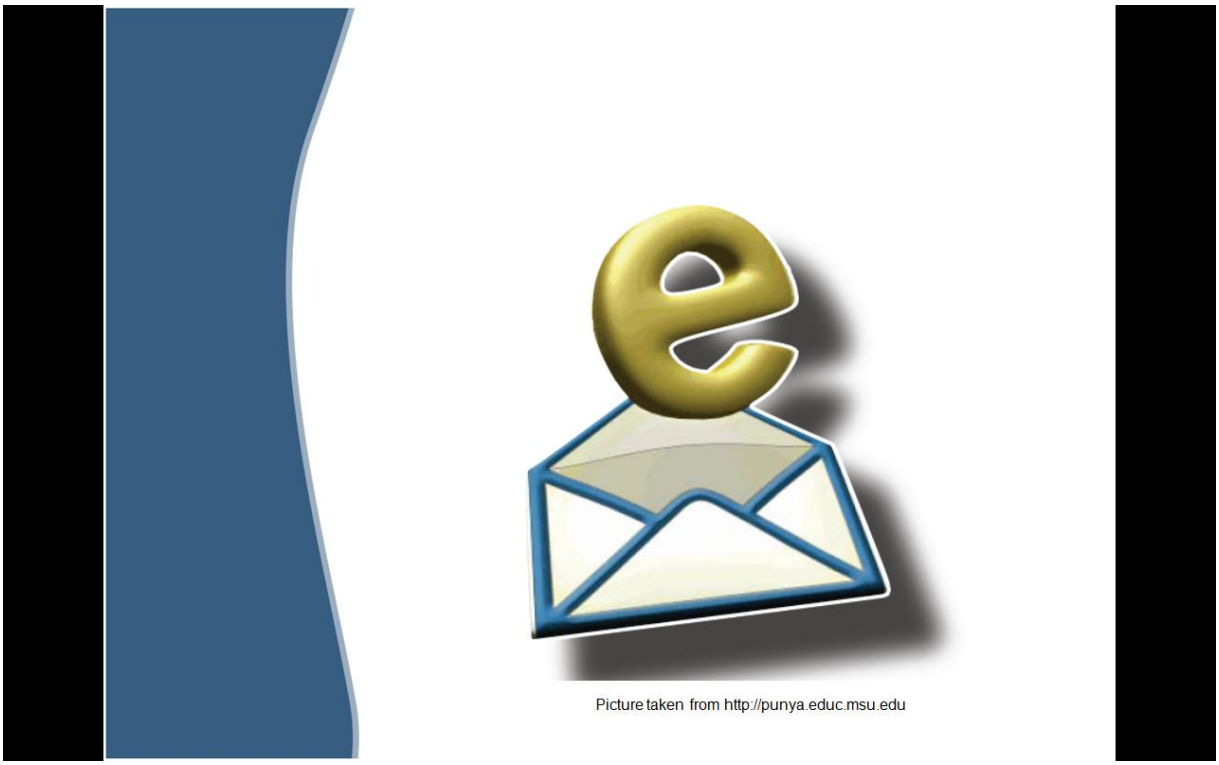
Repurposing technology (in general)

- Technology is not used just one way
- Users use technology in a way not anticipated initially (Mishra & Koehler, 2010).

Slide 21:

Picture taken from http://punya.educ.msu.edu

Slide 22:



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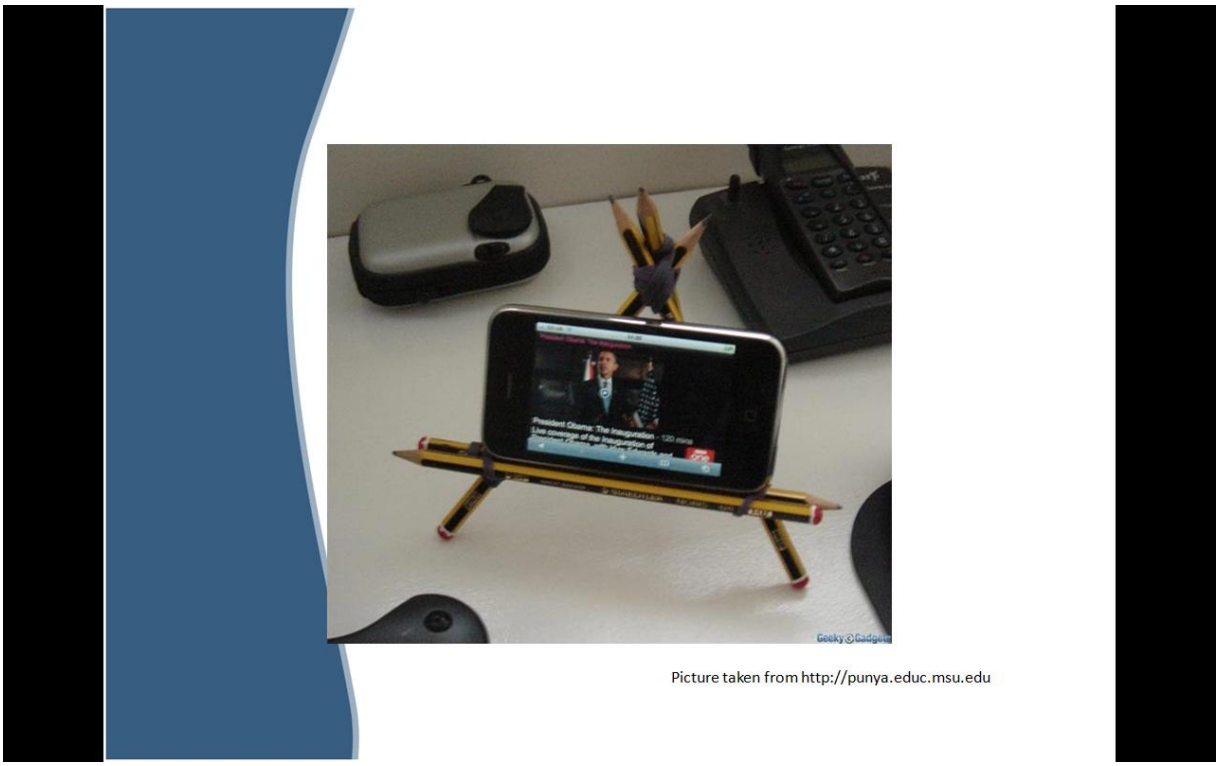

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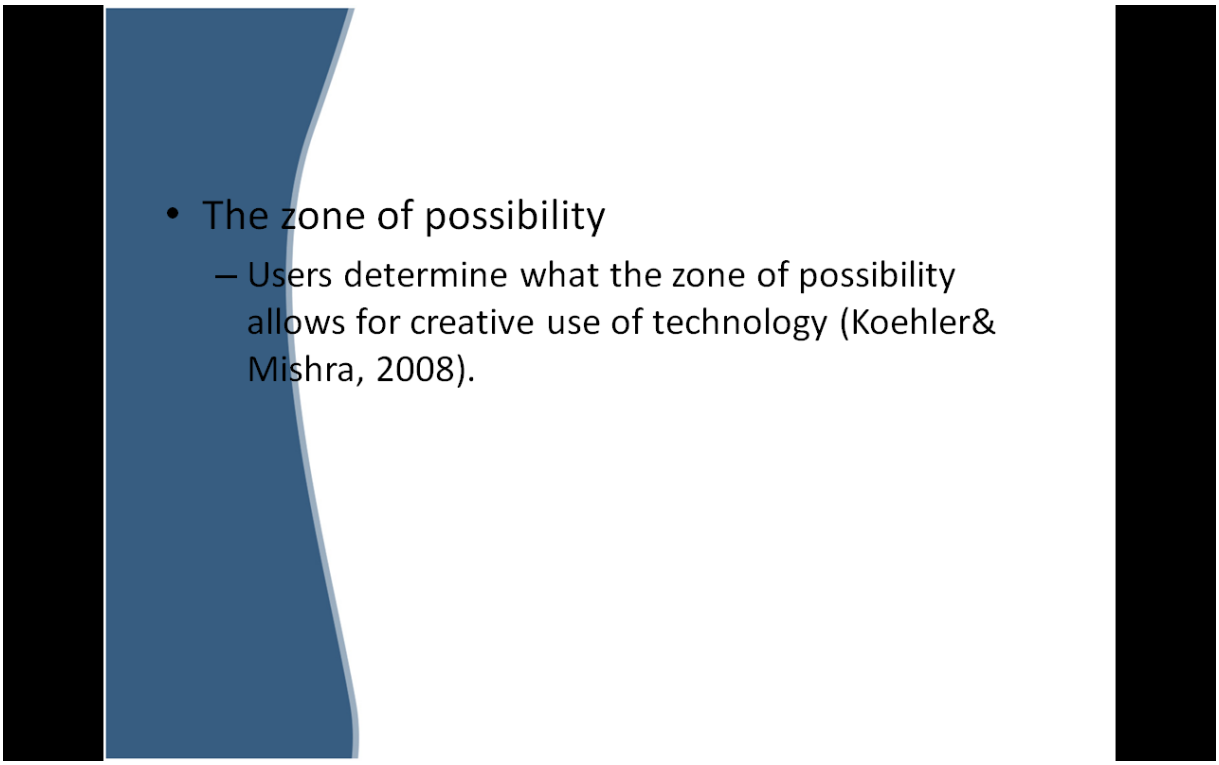

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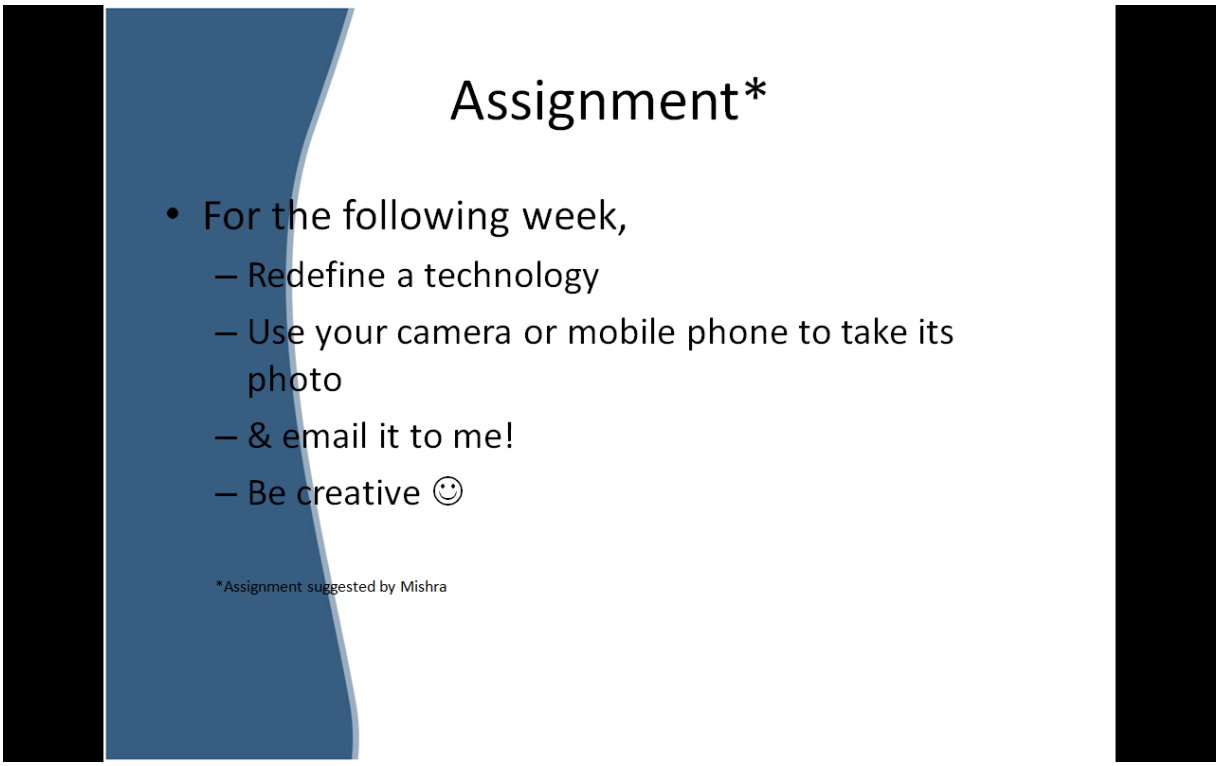

Slide 26:

Slide 27:

Repurposing- education

- Repurposing technological tools for educational purposes, however, is not simple.
- If teachers are to **repurpose** tools and **integrate** them into their **teaching**, they require a specific kind of knowledge- TPACK (Mishra & Koehler, 2010).

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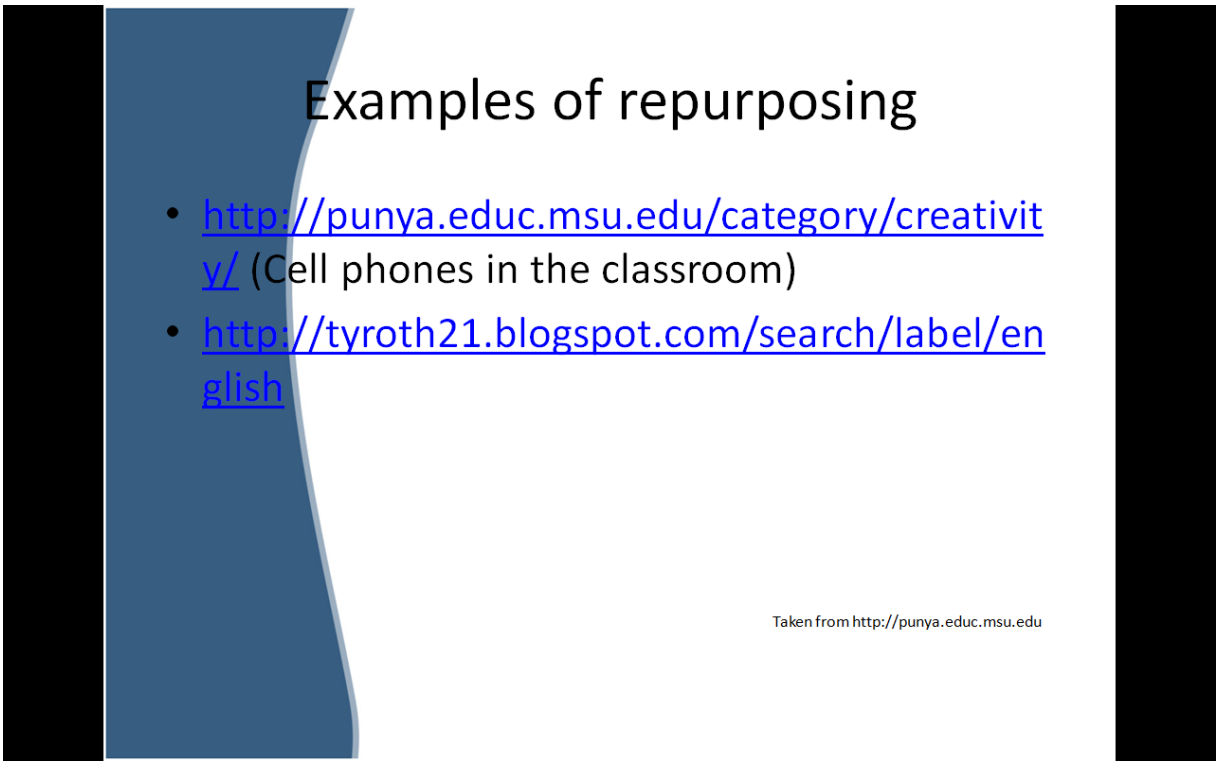

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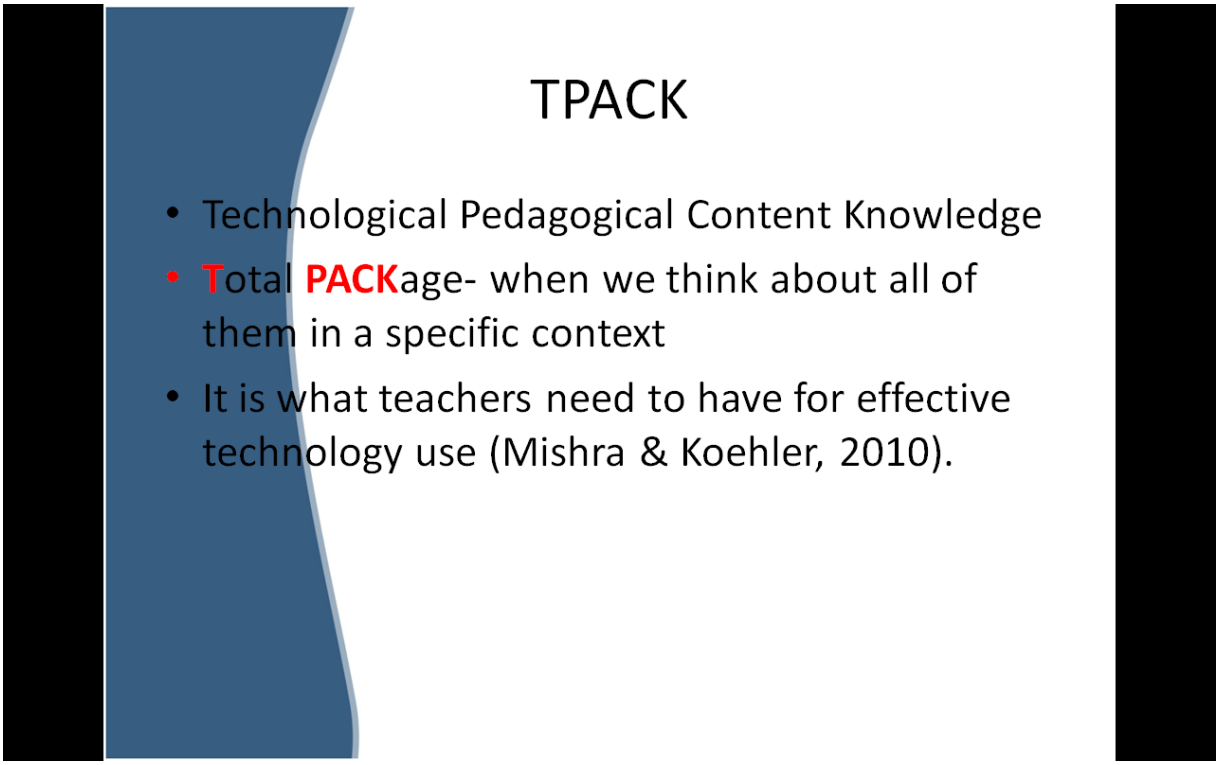


Slide 30:

TPACK

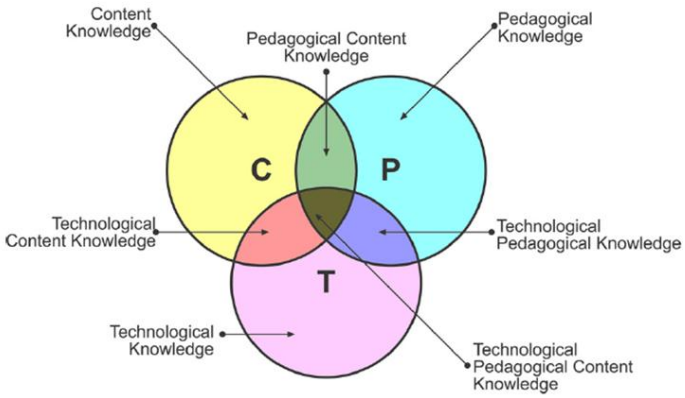


Fig. 1. Pedagogical technological content knowledge.

Figure taken from Koehler, Mishra & Yahya, (2007).

Slide 31:

TPACK

- The skills, competencies, and knowledge specified by the TPACK framework require teachers to go beyond their knowledge of particular disciplines (CONTENT), technologies (TECHNOLOGY)and pedagogical techniques **in isolation** (PEDAGOGY) (Mishra & Koehler, 2010).

Slide 32:

TPACK

- This is a flexible kind of knowledge that lies at the **intersection** of all three of these knowledge bases, allowing the creative **repurposing** of the traditional approaches (Mishra & Koehler, 2010).

Slide 33:

TPACK

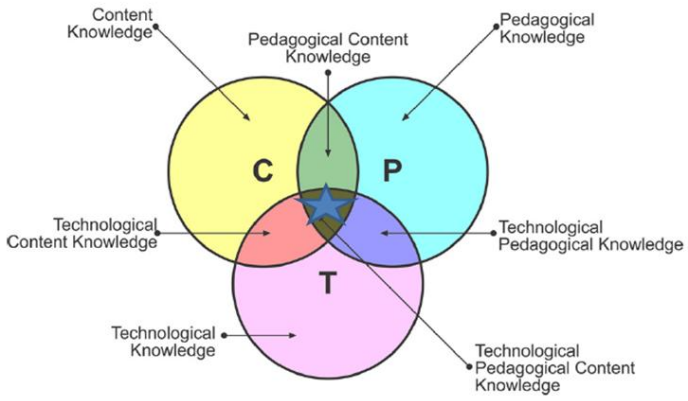


Fig. 1. Pedagogical technological content knowledge.

Slide 34:

TPACK

Whether

or

or

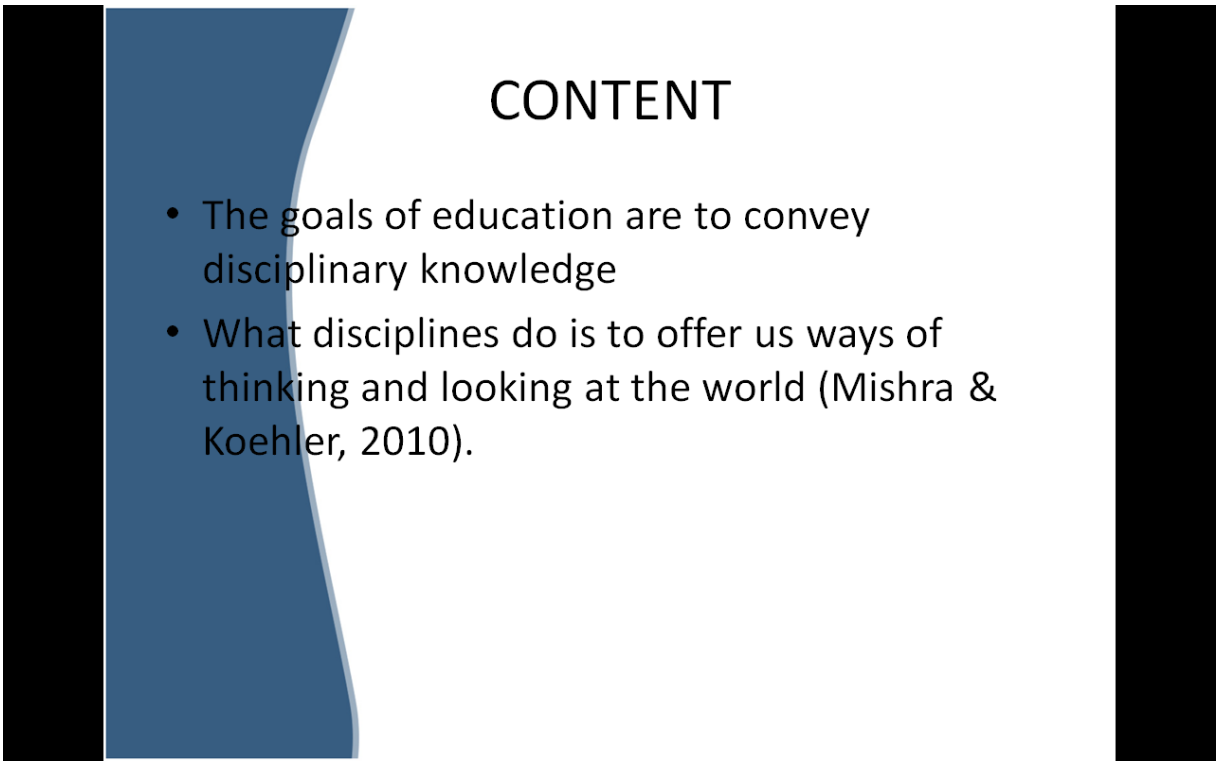
.. teaching is always about TPACK

(Mishra & Koehler, 2010)

Slide 35:

- As teachers, our job involves teaching (PEDAGOGY) students specific subject matter (CONTENT) (Mishra & Koehler, 2010).

Slide 36:



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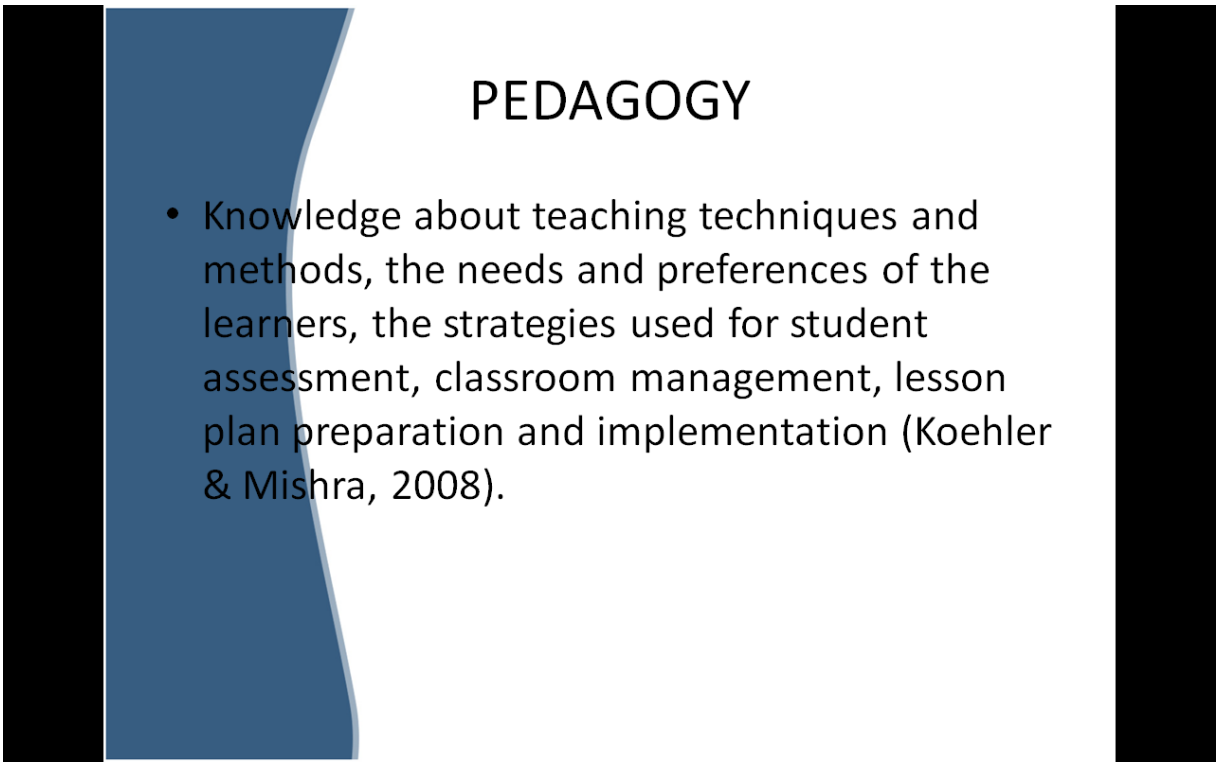

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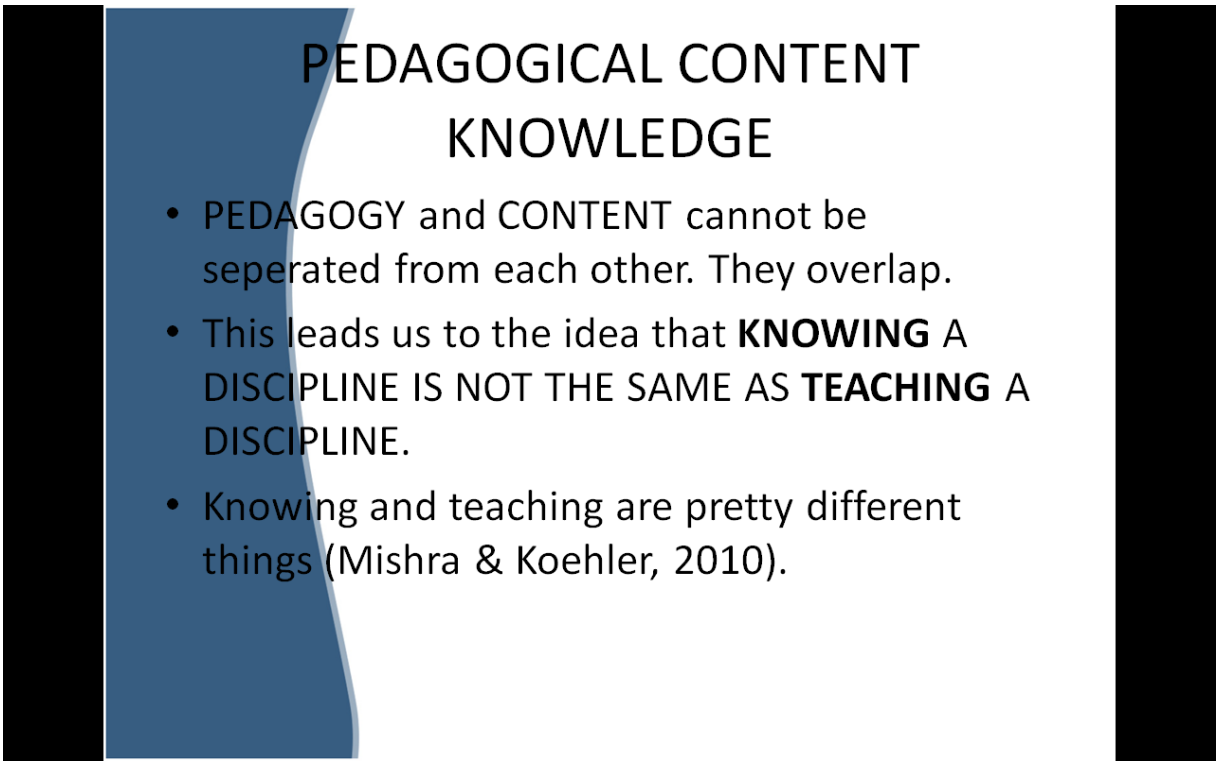

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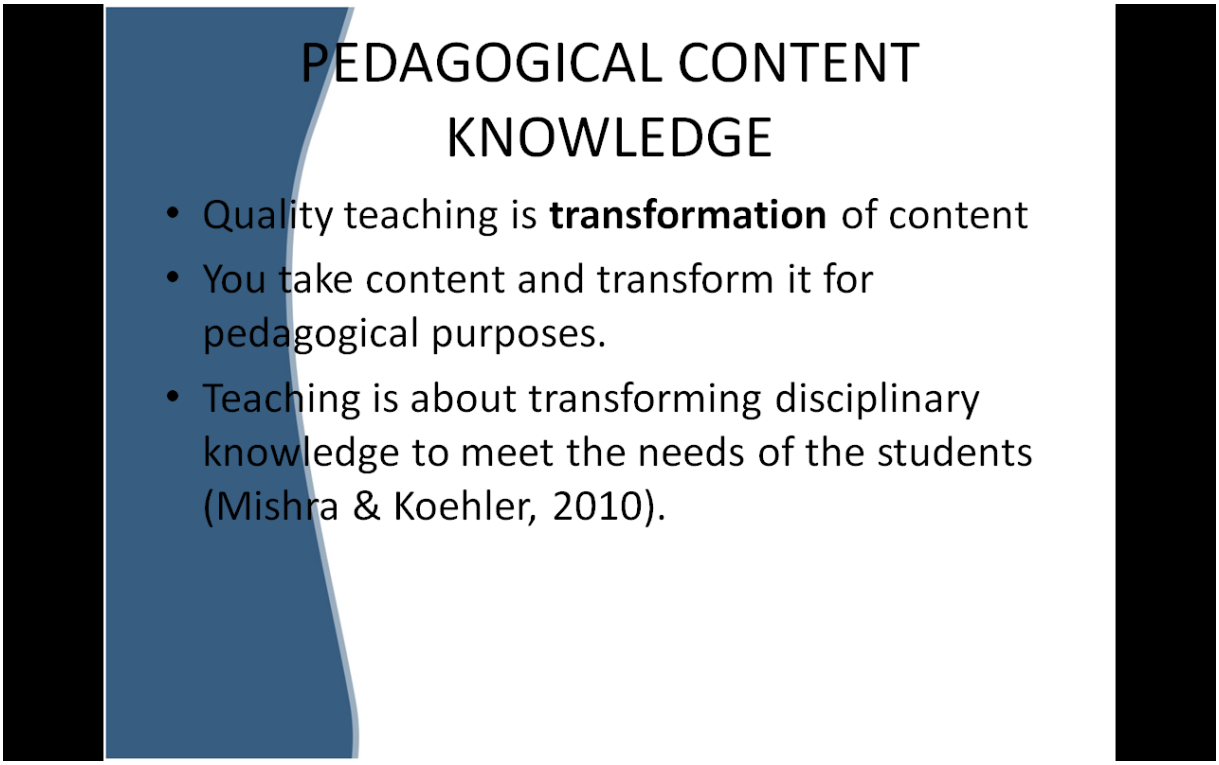

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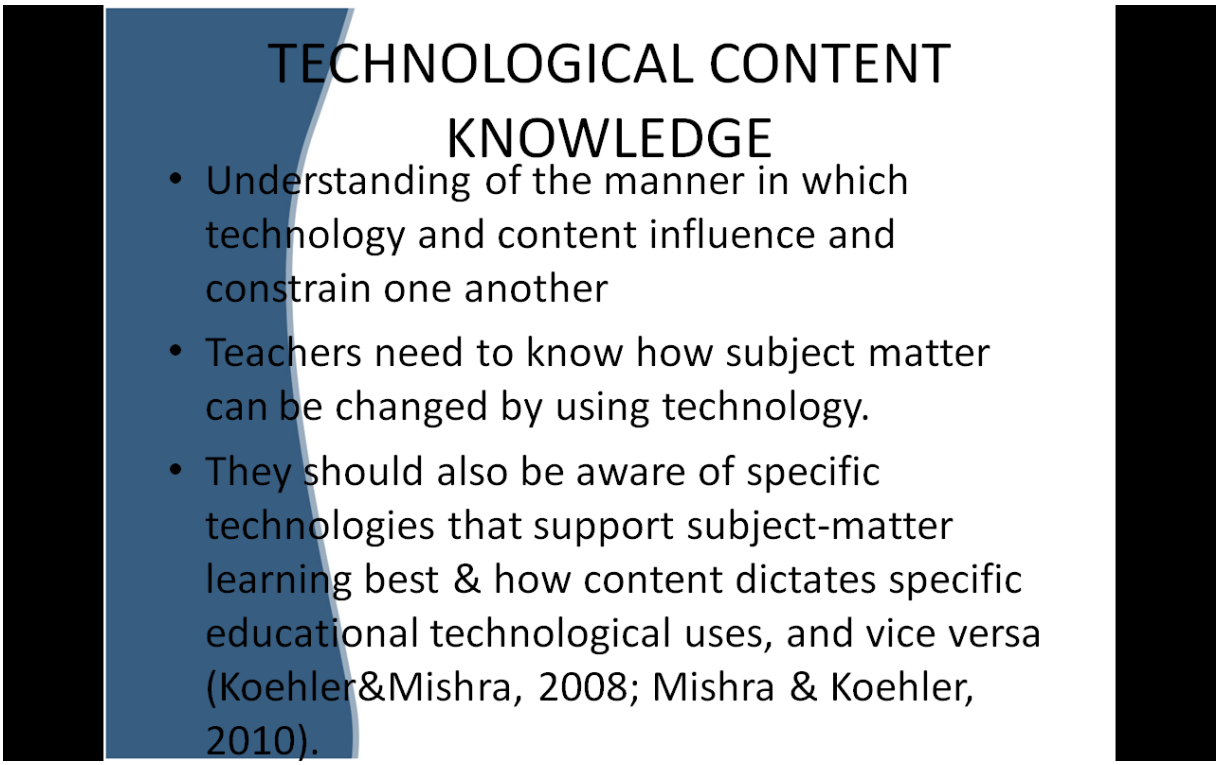

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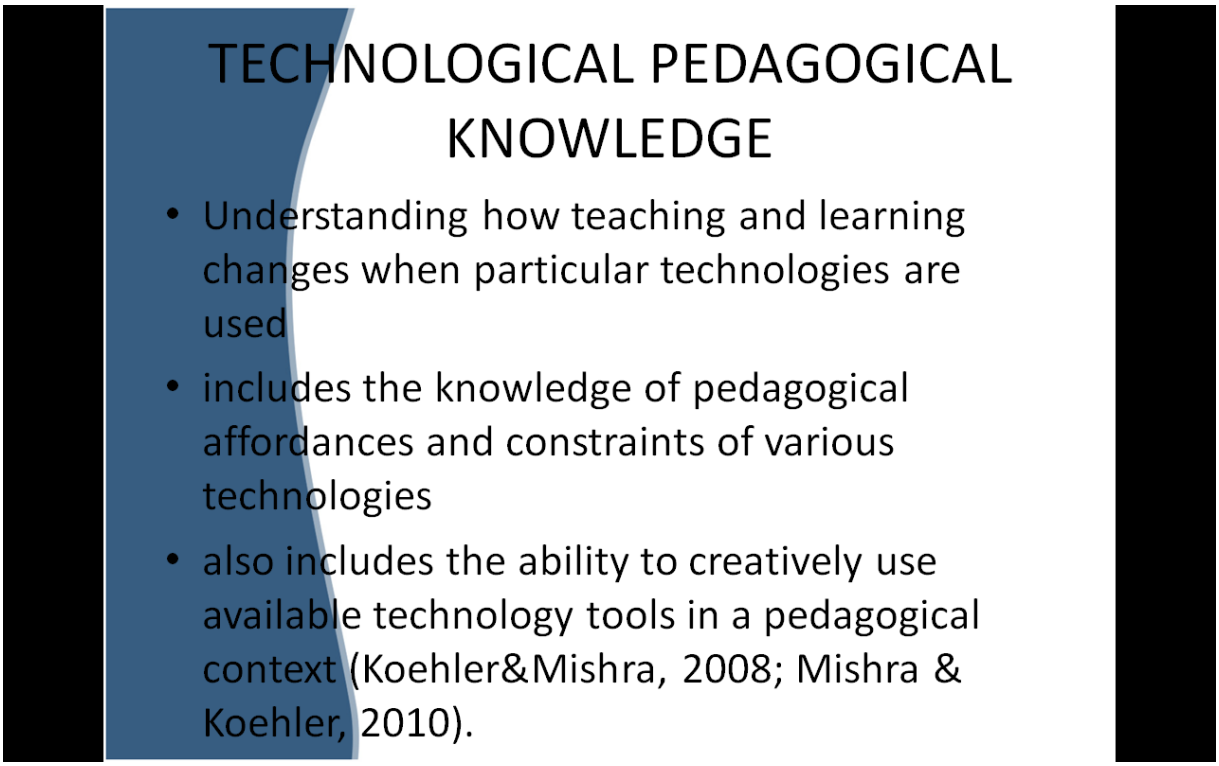


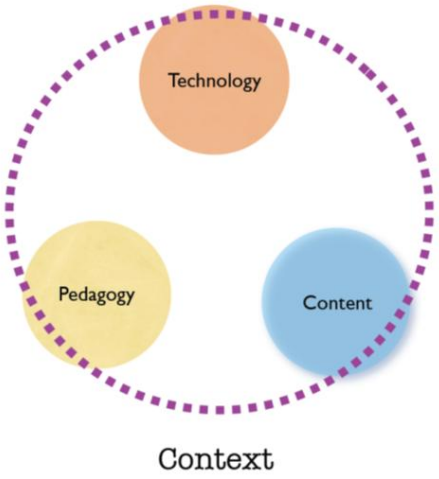
Slide 42:

TPACK- Technological Pedagogical Content Knowledge

- TPACK is different from knowledge of its individual component concepts and their intersections.
- It refers to the complex interrelationship between a teacher's technology use, instructional methods, and understanding of the subject matter (Mishra & Koehler, 2010).

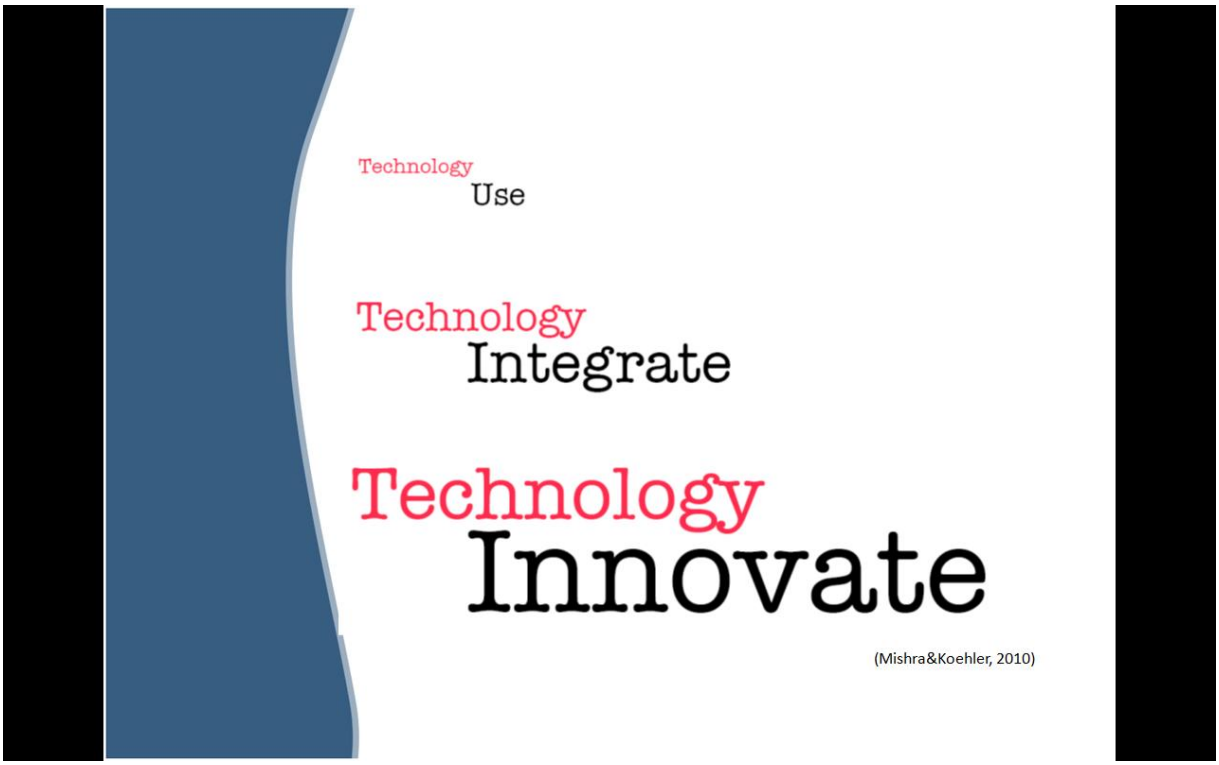
Slide 43:

Context?



Mishra&Koehler, 2010

Slide 44:



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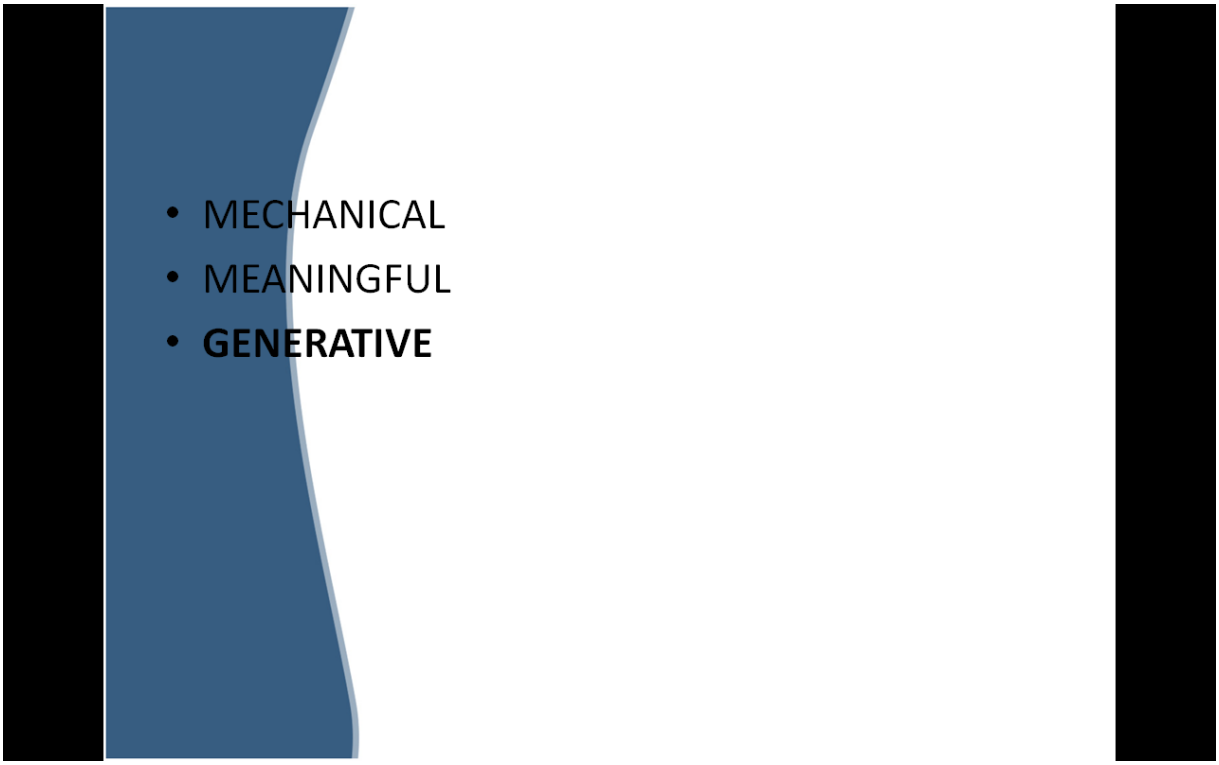

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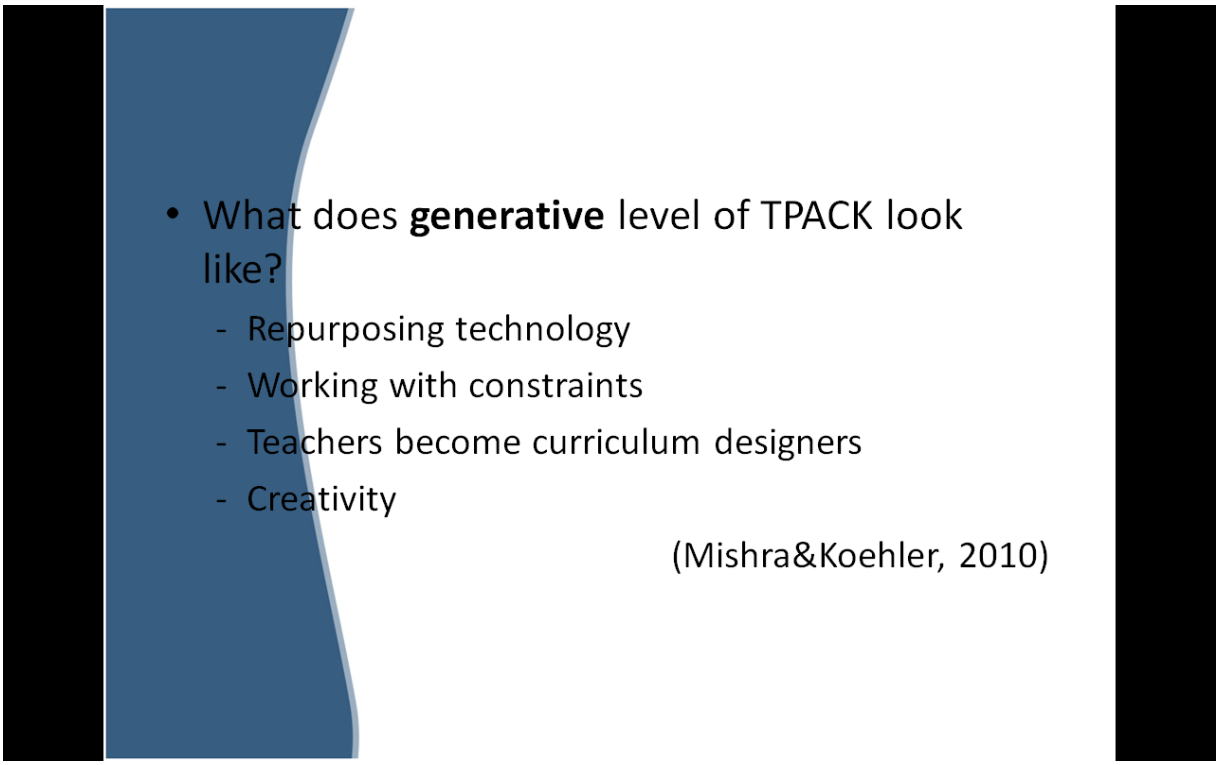

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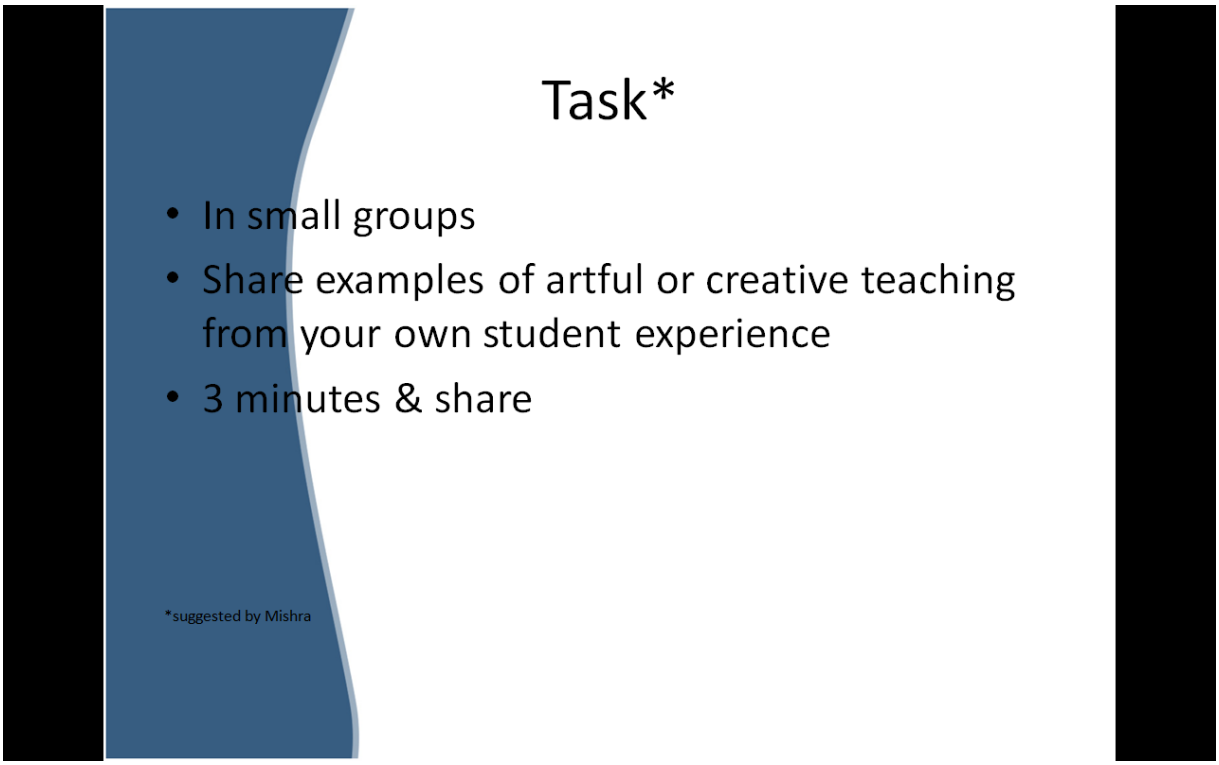

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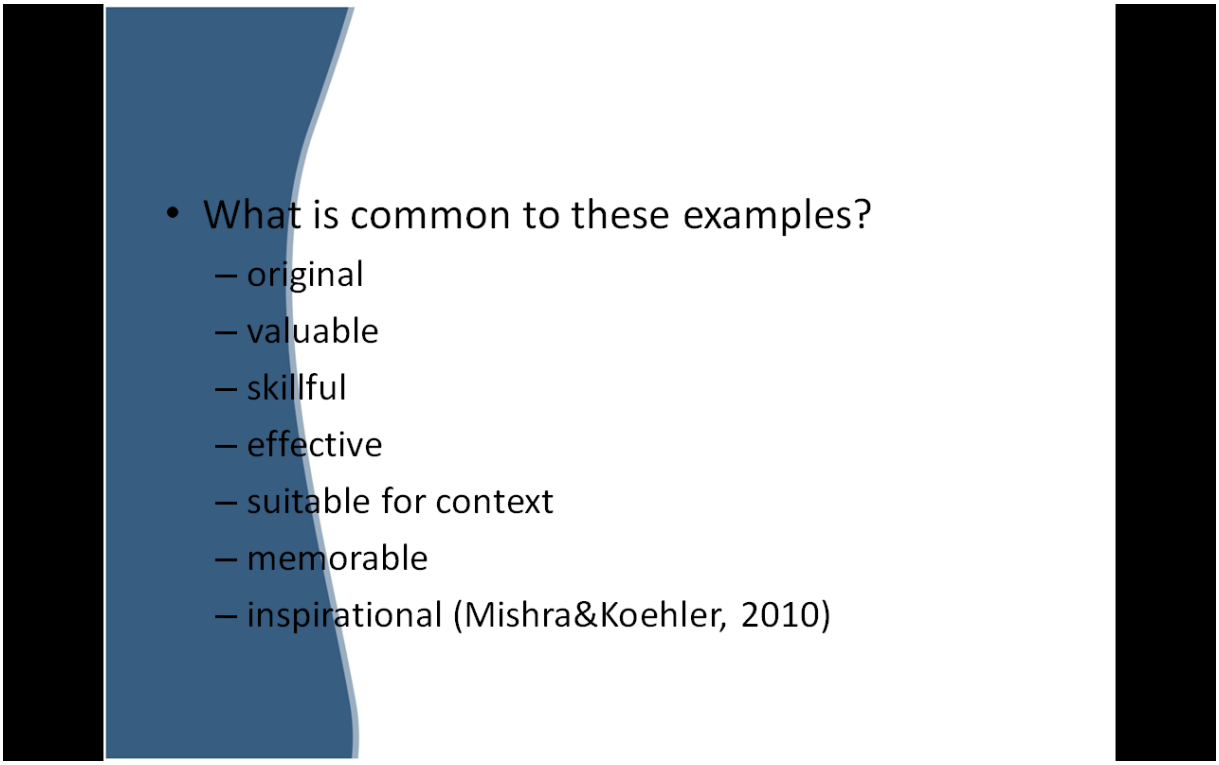

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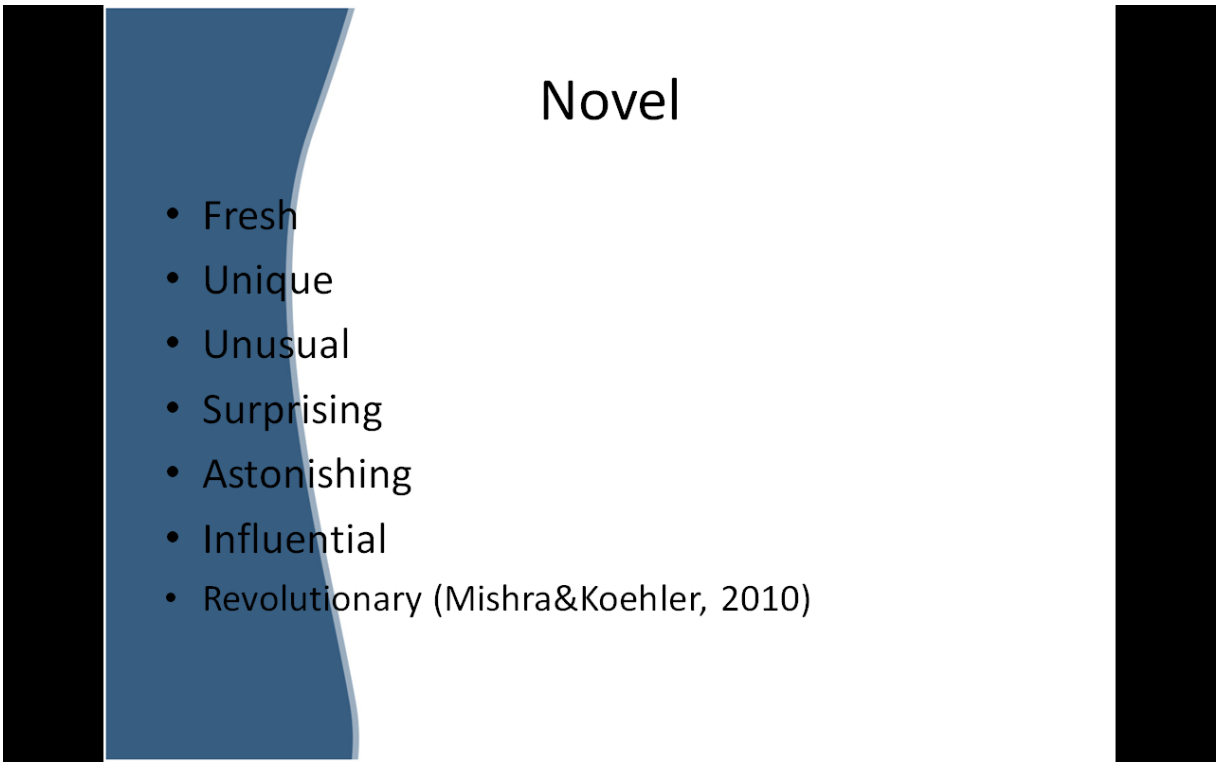

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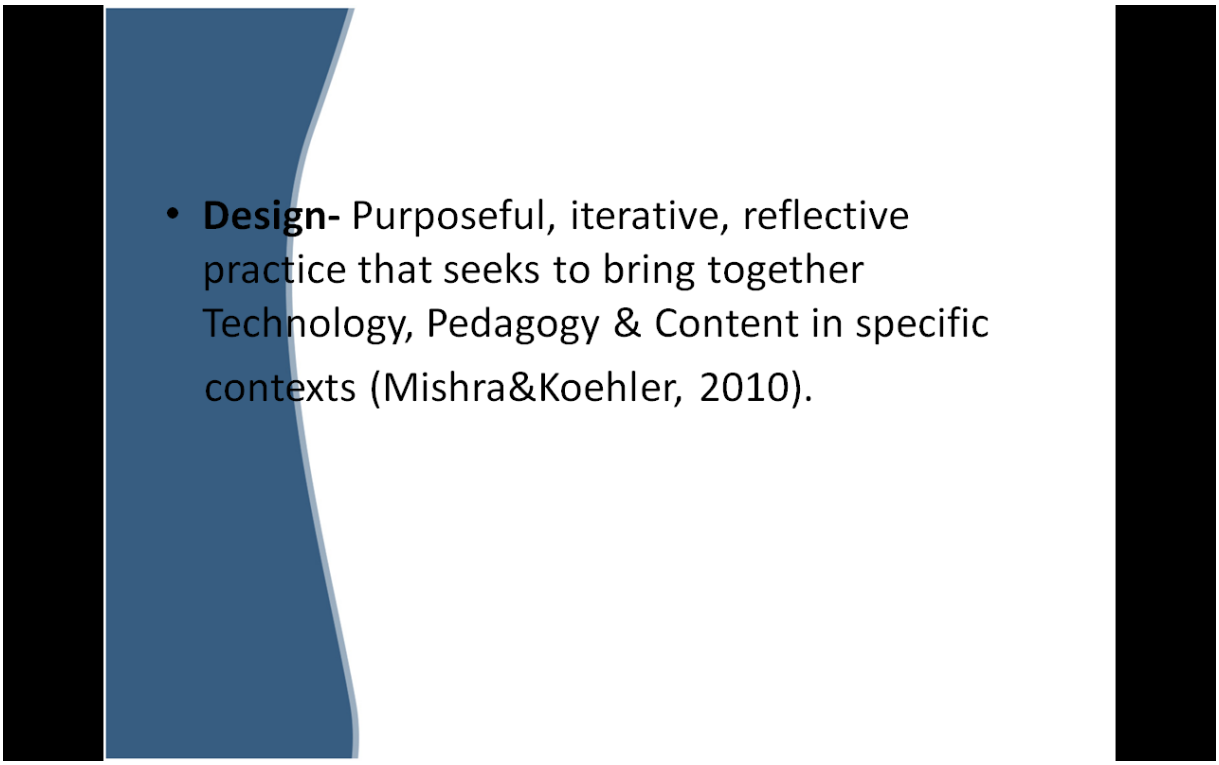

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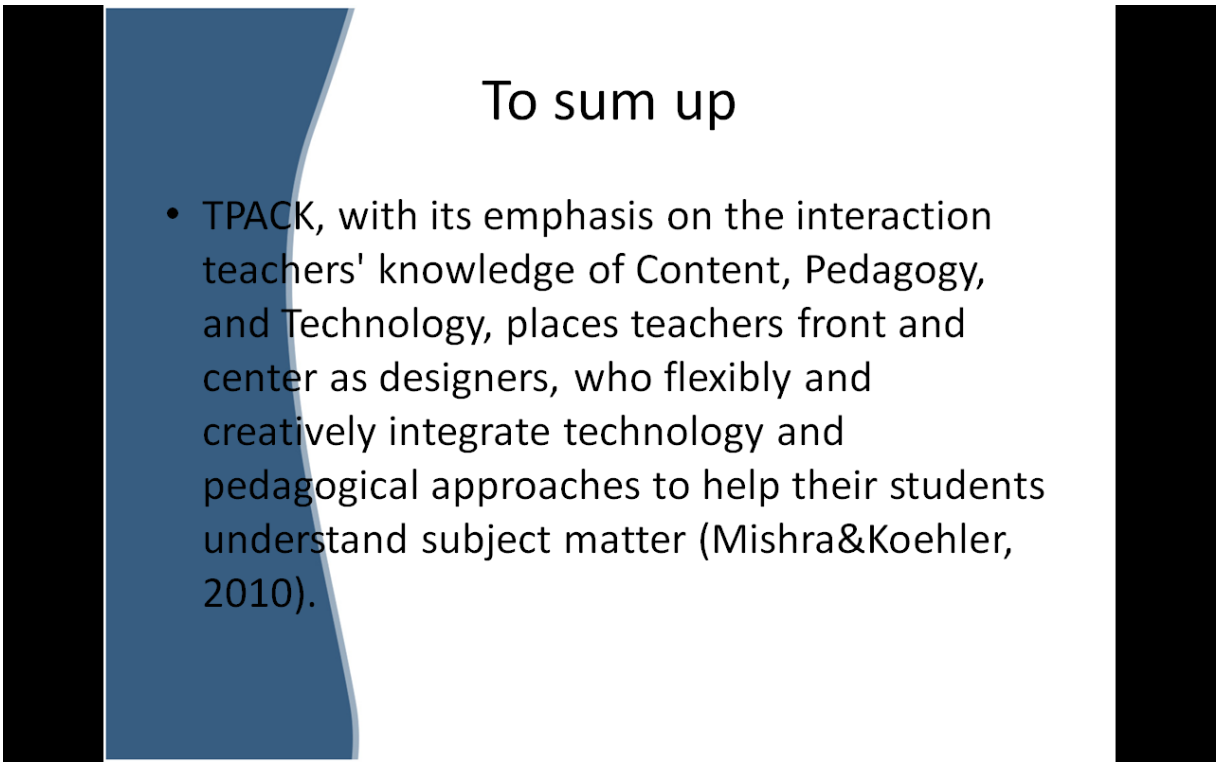

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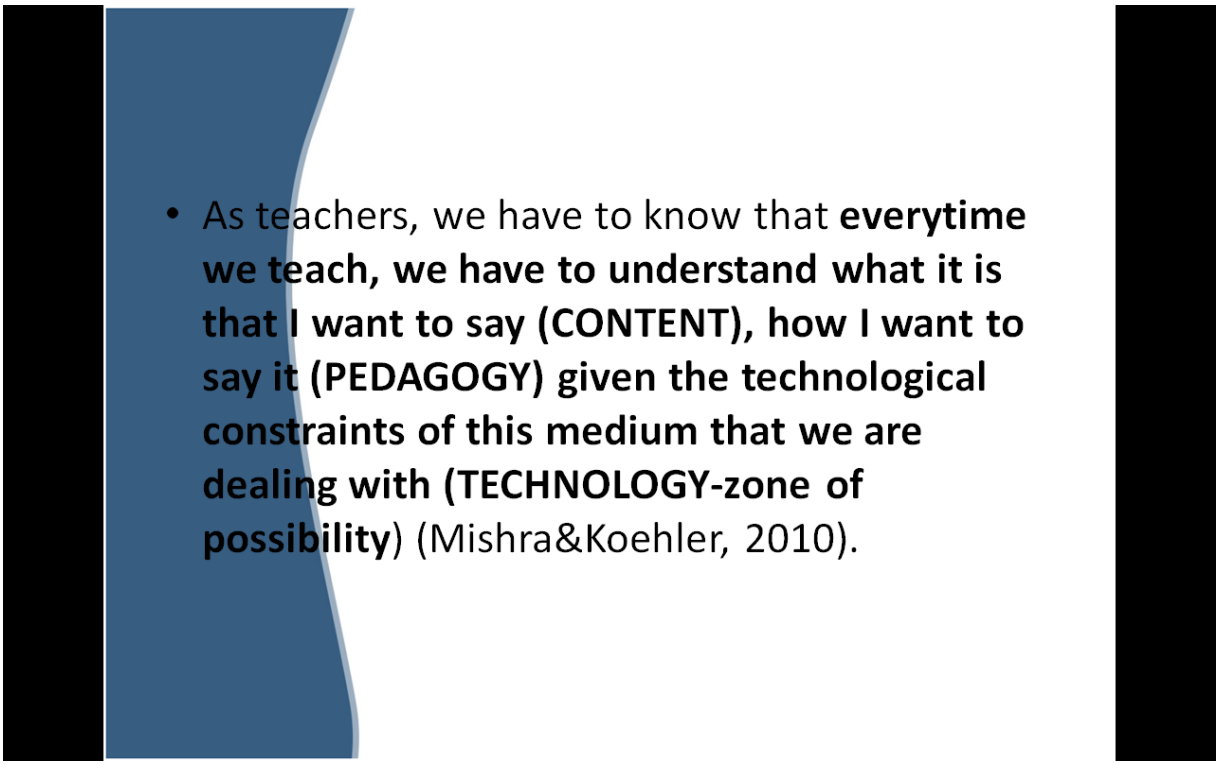

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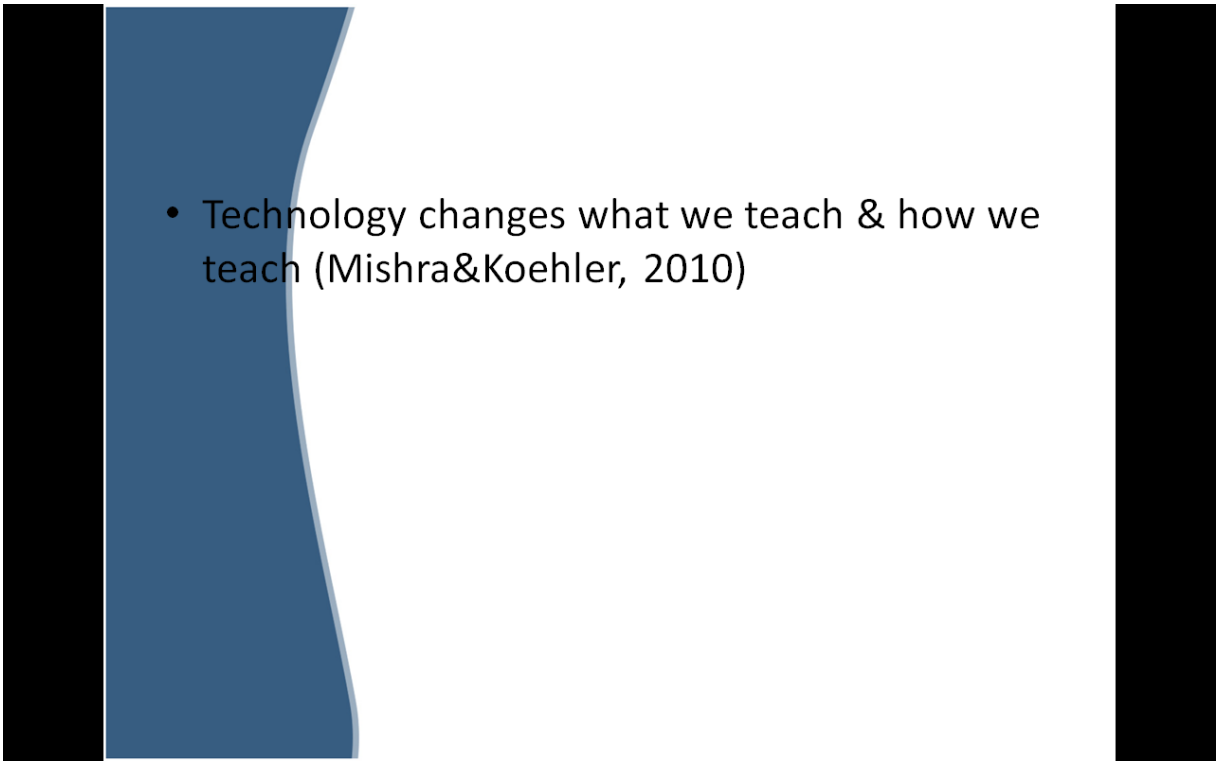

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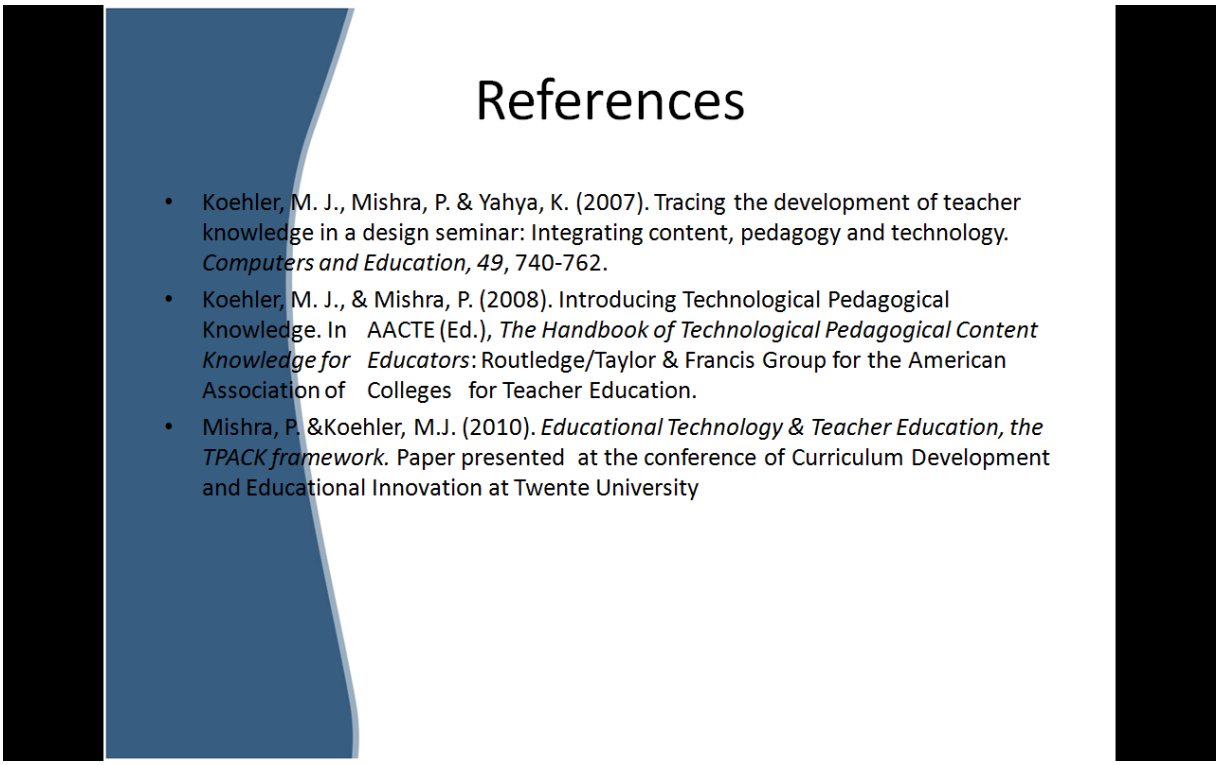
References
Koehler, M. J., Mishra, P. & Yahya, K. (2007). Tracing the development of teacher knowledge in a design seminar: Integrating content, pedagogy and technology. Computers and Education, 49, 740-762.
Koehler, M. J., & Mishra, P. (2008). Introducing Technological Pedagogical Knowledge. In AACTE (Ed.), The Handbook of Technological Pedagogical Content Knowledge for Educators: Routledge/Taylor & Francis Group for the American Association of Colleges for Teacher Education.
Mishra, P. &Koehler, M.J. (2010). Educational Technology & Teacher Education, the TPACK framework. Paper presented at the conference of Curriculum Development and Educational Innovation at Twente University

APPENDIX H

TECHNOLOGY INTEGRATION OBSERVATION INSTRUMENT

Technology Integration Observation Instrument

Observer _____ Teacher _____ Date_____

Grade Level(s) _____ Subject Area(s) _____

Primary Learning Goals _____

Directions:
We have tried to key the components of this instrument to different aspects of teachers' knowledge for technology integration. Please note, however, that the instrument is *not designed to assess this knowledge directly*. It is designed to focus upon the use of technology integration knowledge in observable teaching. Please record the *key curriculum topics addressed, instructional strategies/learning activities observed*, and *digital and non-digital technologies used* by the teacher and/or students in the lesson.

Curriculum Topic	Key Instructional Strategies/Learning Activities	Digital[1] & Non-Digital[2] Technologies

What, if anything, do you know about influences upon what you have observed in this lesson? Examples might include students' learning needs, preferences, and challenges; access to technologies; cultural, language and/or socioeconomic factors.

[1] Computer-based (e.g., software, Web-based resources, video or audio recorder, document camera, calculator)
[2] Not computer-based (e.g., overhead projector, textbook, whiteboard, pen/pencil/marker)

Technology Integration Observation Instrument[3i]

Directions: Referring to the notes you made on the previous page, including your responses to the question about influences, please complete the following rubric, considering the lesson as a whole.

	4	3	2	1
Curriculum Goals & Technologies (Matching technology to curriculum)	Technologies used in the lesson are strongly aligned with one or more curriculum goals.	Technologies used in the lesson are aligned with one or more curriculum goals.	Technologies used in the lesson are partially aligned with one or more curriculum goals.	Technologies used in the lesson are not aligned with one or more curriculum goals.
Instructional Strategies & Technologies (Matching technology to instructional strategies)	Technology use optimally supports instructional strategies.	Technology use supports instructional strategies.	Technology use minimally supports instructional strategies.	Technology use does not support instructional strategies.
Technology Selection(s) (Matching technology to both curriculum and instructional strategies)	Technology selection(s) are exemplary, given curriculum goal(s) and instructional strategies.	Technology selection(s) are appropriate, but not exemplary, given curriculum goal(s) and instructional strategies.	Technology selection(s) are marginally appropriate, given curriculum goal(s) and instructional strategies.	Technology selection(s) are inappropriate, given curriculum goal(s) and instructional strategies.
"Fit" (Considering curriculum, pedagogy and technology all together)	Curriculum, instructional strategies and technology fit together strongly within the lesson.	Curriculum, instructional strategies and technology fit together within the lesson.	Curriculum, instructional strategies and technology fit together somewhat within the lesson.	Curriculum, instructional strategies and technology do not fit together within the lesson.

(over, please)

[3]Adapted from:
Harris, J., Grandgenett, N., & Hofer, M. (2010). Testing a TPACK-based technology integration assessment instrument. In C. D. Maddux, D. Gibson, & B. Dodge (Eds.). *Research highlights in technology and teacher education 2010* (pp. xx-xx). Chesapeake, VA: Society for Information Technology and Teacher Education (SITE).

	4	3	2	1
Instructional Use (Using technologies effectively for instruction)	Instructional use of technologies is maximally effective in the observed lesson.	Instructional use of technologies is effective in the observed lesson.	Instructional use of technologies is minimally effective in the observed lesson.	Instructional use of technologies is ineffective in the observed lesson.
Technology Logistics (Operating technologies effectively)	Teachers and/or students operate technologies very well in the observed lesson.	Teachers and/or students operate technologies well in the observed lesson.	Teachers and/or students operate technologies adequately in the observed lesson.	Teachers and/or students operate technologies inadequately in the observed lesson.

Comments: