HOW SPECIAL ARE TEACHERS OF SPECIALIZED SCHOOLS? A QUANTITATIVE INVESTIGATION OF TURKISH MATHEMATICS TEACHERS' SELF-CONFIDENCE LEVELS IN THE TECHNOLOGY DOMAIN

A MASTER’S THESIS

BY

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THE PROGRAM OF CURRICULUM AND INSTRUCTION
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I certify that I have read this thesis and have found that it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Arts in Curriculum and Instruction.

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ABSTRACT

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The purpose of the current study was to investigate whether specialized high school mathematics teachers, who were selected to educate selected students, were mentally ready to integrate Fatih project technologies into their teaching. The sample consisted of 40 teachers, who voluntarily participated the study and working at randomly-selected specialized and general high schools in Ankara, Turkey. Data collection instrument consisted of 31 items, which were theoretically grouped under four measures of self-confidence in the technology domain. An independent *t*-test revealed that there was no statistically significant difference between specialized and general high school teachers’ self-confidence levels. Results were discussed in terms of previously conducted research on the teacher selection system in Turkey, professional development of teachers, and their knowledge for teaching. It was concluded that the technological pedagogical content knowledge ought to be an essential competency to be sought when selecting specialized school teachers, who educate the future innovators of Turkey.

Key Words: Fatih project, self confidence, social cognitive theory, specialized schools, technological pedagogical content knowledge.

ÖZET

SINAVLA ÖĞRENCİ ALAN ORTAÖĞRETİM KURUMLARINDA GÖREVLİ MATEMATİK ÖĞRETMENLERİNİN TEKNOLOJİ ALANINDAKİ ÖZGÜVEN SEVİYELERİ ÜZERİNE NİCEL BİR ÇALIŞMA

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Bu çalışmanın amacı, sınavla öğrenci alan ortaöğretim kurumlarında görevli matematik öğretmenlerinin, derslerine Fatih Projesi teknolojilerini bütünleştirmeye zihnen hazır bulunuşluklarını araştırmaktır. Örneklem, rastgele seçilmiş genel ve sınavla öğrenci alan ortaöğretim kurumlarında görev yapan ve çalışmaya gönüllü olarak katılan 40 matematik öğretmenidir. Veri toplama aracı teknoloji alanındaki öz güveni ölçen 4 boyut ve toplamda 31 maddeden oluşmaktadır. Bağımsız örneklem *t* testi, genel ve sınavla öğrenci alan ortaöğretim kurumlarında görevli matematik öğretmenlerinin özgüvenleri arasında istatistiksel olarak anlamlı bir fark olmadığını ortaya çıkarmıştır. Sonuçlar, Türkiye'deki öğretmen istihdam sistemi, öğretmenlerin profesyonel gelişimleri ve öğretmenlik bilgileri üzerine yapılmış araştırmalar göz önüne alınarak tartışılmıştır. Sonuç olarak, teknolojik pedagojik alan bilgisinin, sınavla öğrenci alan ortaöğretim kurumlarında görev yapacak ve geleceğin liderlerini yetiştirecek olan öğretmenlerin seçimi aşamasında kullanılması gereken bir yeterlilik olduğu sonucuna varılmıştır.

Anahtar Kelimeler: Fatih Projesi, özgüven, sınavla öğrenci alan ortaöğretim kurumları, sosyal öğrenme kuramı, teknolojik pedagojik alan bilgisi.

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CHAPTER 1: INTRODUCTION

Technology continues to have a major impact on our society through its role in the education of young generations. Vision 2023 of Turkey, a foresight exercise prepared by the Scientific and Technologic Research Council of Turkey (2005), indicates that the improvement of the infrastructure in Turkey, possibly empowered by the intense interest shown towards technology, brings along extensive use of technology in daily and professional life. According to The State Planning Organization (SPO, 2011), technology will continue to regulate education in Turkish classrooms, as well. In alignment with the increasing role of technology in the society, a positive change in the education quality in Turkish classrooms is warranted to make education more student centered, lifelong, and independent from its physical limitations.

Such a positive change in schooling can happen with the help of technologically literate teachers. As the main facilitator of learning in the classroom, teachers need to adopt the change and learn how to incorporate technology into their teaching. In addition to their role as the instructors of their subject-area, teachers have the potential to lead the process of educational change in the society, as well. Through this change, which is centered around technological advances, the constraints that limit the innovation capacity of our society may come to an end (Kaput, 1992; Turkish Academy of Sciences, 2009). Turkey needs pioneering teachers, who will educate the future innovative leaders of our country.

Technology has been an important tool, particularly for the teaching and learning of mathematics. Technology enhances student learning in mathematics by enabling students to interact with mathematical structures and to formulate their own rules and conjectures (National Council of Teachers of Mathematics [NCTM], 2000). Through technology, teachers extend the mathematics they teach by bringing realistic settings into their classrooms (Alacaci & McDonald, 2012; Drijvers & Doorman, 1996; Erdogan, Corlu & Capraro, 2013; Kaput & Thompson, 1994; Özel, Yetkiner & Capraro, 2010; Özgün-Koca, 2012). Technology has been instrumental for both the students and teachers in the way they do mathematics.

Mathematics teachers need to be well-equipped to integrate technology in their teaching. Based on Shulman’s (1986) fundamental theory on teaching knowledge, which claims that “mere *content* knowledge is likely to be as useless pedagogically as content-free skill” (p.8), mathematics teachers’ ability to effectively utilize technology in their teaching is often dependent on a variety of factors. Koehler and Mishra (2005) explained these factors under the technological pedagogical content knowledge (TPCK) construct. This new construct emerges at the nexus of knowledge, skills, and beliefs that are needed to effectively use technology in subject-specific teaching. Therefore, TPCK sets the foundation for a successful use of technology in performing mathematics so that innovation can be fostered in the Turkish classrooms and in our society.

Background of the study

Policy makers in Turkey have been trying to reform mathematics education, aiming to improve students' problem solving skills and to enable students to apply their mathematical knowledge in real life situations through technology (Stanic & Kilpatrick, 1992). These reforms go beyond fostering the use of technology as a teacher's aid or a calculation tool. These reforms encourage teachers to utilize technology as a tool to develop students' higher order mental skills, such as modeling, analyzing, and making generalizations (Ministry of National Education [MoNE], 2013a). Turkish teachers need to be ready to make correct decisions about when and how to use technology and to ensure that technology is facilitating students' learning and improving their mathematical thinking levels (Baki, 2011; NCTM, 2000). Therefore, there exists a need for mathematics teachers to be well-equipped to integrate technology into their teaching.

Despite all the support systems that are available to Turkish teachers, they experience some challenges which are similar to those experienced by their counterparts in other countries. From an idealistic point of view, Kaput (1992) stated that the major limitation of effectively using technology in the classrooms is the lack of human imagination. This limited human imagination and restraint of old habits are among teachers' greatest challenges. However, when examined from a more pragmatic point of view, inadequate knowledge of the curriculum and instructional methods emerge as more immediate difficulties for teachers (Niess et al., 2009). Supporting this pragmatic view, Ferrini-Mundy and Breaux (2008) said "[in] the absence of professional development on instructional technology and curriculum materials that integrate technology use into the lesson content, teachers are not particularly likely to embed technology-based or technology-rich activities into their courses" (p. 437). Both the idealistic and the pragmatic approaches emphasize the need to provide a nation-wide effort to improve the readiness of teachers, especially the teachers at selective specialized schools who prepare the future innovators of the country

(MoNE, 2012a). In order to address this need, MoNE has begun to develop large-scale projects (e.g., Fatih Project).

Fatih Project is a large-scale project that aims to increase the use of technology in Turkish schools. This Project encompasses equipping Turkish classrooms with highly advanced technological tools, including smart boards, projection machines, internet connection, electronic and enriched books (Zenginlestirilmis kitap in Turkish), and tablet PCs (MoNE, 2012a). A much needed component of the project is the professional development of teachers, based on claims that Turkish teachers are inclined to misinterpret technology as a presentation or activity tool, rather than an integral part of their teaching (Altan, 1998). Fatih Project aims to help Turkish teachers integrate high-end educational technologies into their teaching.

Turkish mathematics teachers may not be any different from their colleagues in their difficulties regarding the use of technology that comes with the Fatih Project. Previous research indicates that teachers are not ready to adopt such advanced technologies (Timur, 2011). In addition to the knowledge dimension of this readiness, the self-confidence levels within the context of TPCK is also important (Kayaduman, Sırakaya, & Seferoğlu, 2011). Given the large resources allocated for the Fatih Project, investigating the readiness of mathematics teachers in all dimensions is warranted.

Problem

Teachers are the most essential element of any reform movement. Fatih Project needs more pioneer teachers who are ready to utilize advanced technologies (Kayaduman, Sırakaya, & Seferoğlu, 2011). Aligned with the goals of the Fatih Project, the new Turkish mathematics curriculum encourages teachers to use technology for teaching mathematics conceptually (MoNE, 2013a). Because this project constitutes several challenges for Turkish mathematics teachers, there is a need to investigate whether Turkish mathematics teachers are mentally ready to overcome these potential problems.

The elite nature of the Turkish educational system provides a limited number of selected students with the best available education in specialized secondary schools (i.e. Anatolian schools) (Corlu, 2012; Özel, Yetkiner, Capraro & Küpçü, 2009). Because the teachers of these schools are selected and appointed based on their scores on a government-administered centralized examination, it is noteworthy to investigate whether these pioneer teachers are mentally ready to lead selected students to become the future innovators of Turkey.

Purpose

The main purpose of this study is to investigate Turkish mathematics teachers' mental readiness to facilitate an effective teaching through the Fatih Project. Mental readiness is defined in this study as teachers’ self-confidence levels within the TPCK domain. Specifically, self-confidence levels within the TPCK domain of general high school mathematics teachers are compared to the specialized high school teachers' levels of TPCK self-confidence.

Hypotheses

In comparing TPCK self-confidence levels of mathematics teachers working at selective high schools and general high schools, the null and alternative hypotheses are as follows:

$$H_0: \mu_1 = \mu_2$$

and

$$H_1: \mu_1 < \mu_2$$

where μ_1 stands for the mean of general high school teachers' TPCK self confidence level scores, and μ_2 stands for the mean of specialized high school teachers' TPCK self confidence level scores in the population. The null hypothesis (H_0) states that there is no statistically significant difference between population means in technological pedagogical content knowledge (TPCK), technological content knowledge (TCK), technological pedagogical knowledge (TPK), and technological knowledge (TK) scales. The alternative hypothesis states that there is a statistically significant difference between population means in these four scales and it was hypothesized that the mean of specialized high school teachers' TPCK self-confidence level scores are higher than the mean of general high school teachers' TPCK self-confidence level scores.

Research questions

The primary research question of the current study is:

Is there a statistically significant difference between TPCK self-confidence levels of general high school mathematics teachers and specialized high school mathematics teachers for teaching in the Fatih Project?

In addition to the main research question, this study seeks answers to the following secondary questions:

- Is there a statistically significant difference between TPK self-confidence levels of general high school mathematics teachers and specialized high school mathematics teachers in the domain of the Fatih Project?
- Is there a statistically significant difference between TCK self-confidence levels of general high school mathematics teachers and specialized high school mathematics teachers in the domain of the Fatih Project?
- Is there a statistically significant difference between TK self-confidence levels of general high school mathematics teachers and specialized high school mathematics teachers in the domain of the Fatih Project?

Intellectual merit and broader impact

This study advances our knowledge regarding the self-confidence levels of Turkish mathematics teachers in the TPCK domain. The notion of technology integration through the Fatih Project has been superficially supported by MoNE. The Fatih Project is a milestone step towards student-centered education that offers a variety of opportunities for a better learning and teaching environment (MoNE, 2012b). This study has the potential to provide solid empirical research evidence on the mental readiness of our teachers to operate within the Project directives.

The findings of the study may also have some broader influences on the MoNE's teacher employment system. The elite nature of specialized schools requires an elite collection of teachers to be employed, given that these schools are founded to educate the future innovators of the country (Özel, Yetkiner, Capraro & Küpçü, 2009). By the end of the current study, it may be possible to provide MoNE with some suggestions for their efforts in improving the Public Personnel Selection Examination (PPSE), in addition to the selection system of teachers for specialized schools. From this perspective, the study has the potential to show that a system based on selecting teachers merely on content knowledge is not enough (Gür & Çelik, 2009; Özoğlu, 2010). Thus, the study may be useful in informing Turkish policy makers on the MoNE's teacher employment system.

Definition of key terms

CK: Content knowledge is the knowledge about only the subject matter that is learned or taught (Shulman, 1986).

TK: Technology knowledge (TK) is the knowledge about both standard and more advanced digital technologies—such as books, chalk and blackboards, internet and digital video. TK refers to knowing how to use these technologies (Mishra & Koehler, 2006).

PCK**:** Pedagogical content knowledge is related to what extent teachers know about the content that they teach to students plus to what extent they know about teaching, its pedagogy (Shulman, 1986). Thus, PCK is the issue which distinguishes the subject area teachers from the subject area experts, scientists. Also, it includes the powerful expressions and beneficial images that help to make a topic comprehensible for others (Ball & Bass, 2002). Pedagogical content kowledge has 4 elements: Knowledge of pedagogy, knowledge of students, knowledge of subject matter, and knowledge of environmental context (Işıksal, 2006).

TPCK**:** Technological pedagogical content knowledge is the integration of technology into PCK. TPCK has 3 elements: technological knowledge, pedagogical knowledge, and content knowledge. TPCK refers to the understanding of effective teaching with technology (Koehler & Mishra, 2005).

Technology integrated instruction: It is the set of instructional strategies that concern technological tools—such as smart boards, tablet PCs, video, and animation (Timur, 2011).

TPCK self-confidence: The self-confidence of teachers regarding the items of TPCK (Timur, 2011).

Specialized high schools: Turkish schools that select the ablest students to prepare them as future innovators of the country (Corlu, 2012; Berberoğlu & Kalender, 2005).

Mental readiness: Teachers' self-confidence levels within the TPCK domain.

Quality assurance systems for teachers: The ways to measure the quality of work of individual teachers or to evaluate their teaching performances, or methods used for hiring decisions of teachers.

TIMMS: The Trends in International Mathematics and Science Study.

OECD: The Organisation for Economic Co-operation and Development.

TALIS: Teaching and Learning International Survey.

PISA: Program for International Student Assessment.

MoNE: Ministry of National Education.

PPSE: Public Personnel Selection Examination.

SSPC: Student Selection and Placement Center.

SSTSE: Specialized Schools Teacher Selection Examination.

CHAPTER 2: LITERATURE REVIEW

Introduction

This chapter established the theoretical framework of this study. The purpose was to present a synthesis of theory and research on reforms in mathematics education, teachers' knowledge, Pedagogical Content Knowledge (PCK), Technological Pedagogical Content Knowledge (TPCK), teachers' self-confidence levels, the Fatih Project, specialized schools, and the teacher employment system in Turkey. First, the role and the impact of technology in reforming mathematics teaching and learning for the 21st century have been explored through a rigorous analysis of relevant studies. This section provided the readership with a research-based rationale why technology was the driving force behind reforms in the Turkish mathematics education, in alignment with the reforms in some influential countries around the world. Second, the teachers' role in reforms as agents of change has been explained. Research in this area highlighted the need for qualified teachers for a successful implementation of the reforms and what specific qualifications would positively impact teaching practices in the classroom setting. The connection between PCK and TPCK was the focus of this section. Third, the Fatih Project was explored. The rationale for the Fatih Project was given as an information along with the research evidence that explored the responsibilities of teachers in similar projects. Finally, the current teacher employment system in Turkey was critically analyzed.

The role of technology in reforming mathematics education

Turkish political leadership has introduced several curricular reforms in recent years based on the ambition of becoming a leading country in mathematics education in the 21st century. The rationale behind these reforms was the poor results obtained on international comparison studies, such as the Program for International Student Assessment (PISA) and the Trends in International Mathematics and the Science Study (TIMSS) (Zembat, 2010). Turkey ranked 43th (out of 65 countries) in the 2009 PISA study and 24th (out of 42 countries) in the 2011 TIMMS study at the 8th grade level. These results indicated that Turkish students' mathematical performances were lower than the mathematical performances of students in other developed countries (National Center for Education Statistics, 2012; Organisation for Economic Co-operation and Development [OECD], 2010). The subpar results of Turkish students' performances, particularly in mathematics and science, alerted policy makers to reconsider the structure and organization of the existing Turkish mathematics and science education.

One common feature of curricular reforms in many countries, which had poor results in TIMSS or PISA, was to place an emphasis on technology use as an imperative tool to ensure equity among students from different regions of their countries and to widen the access to quality mathematics education (NCTM, 2008). A second commonality was the motivation of policy makers to use technology as a way to tackle traditional teaching practices in the classroom level (Newby, Stepich, Lehman, & Russel, 2000). A third common feature of many curricular reforms was the necessity of benefiting from the information and communication technologies for a more active learning of mathematics (MoNE, 2013a). As a result of the need for using information technologies in the instructional process, policy makers in Turkey put technology on the top of their agenda to educate the current generation according to the needs of the 21st century.

Policy makers in Turkey have been working to develop a mathematics curriculum that would help the current generation to be better prepared for the 21st century. The common objective of the Turkish reforms, aligned with the international efforts, was to improve students' problem solving skills and enable students to apply their mathematical knowledge in real life situations through technology (MoNE, 2013a; Stanic & Kilpatrick, 1992). In fact, the National Council of Teachers of Mathematics (NCTM, 2008) was instrumental in guiding these worldwide reform efforts. This Council advised that technological tools such as tablet PCs, applets, interactive whiteboards, and interactive calculators might help teachers to perform better in their profession. In several studies in Turkey and abroad, researchers found that a technology-empowered mathematics education improved students’ critical thinking and reasoning skills, developed a positive disposition for mathematics, and helped students be more prepared for life (Alakoç, 2003; Baki, 2001; Mercan, Filiz, Göçer & Özsoy, 2009; Niess et. al., 2009). Policy makers of Turkey initiated curricular reforms, aligned with these international reform efforts to integrate technology into mathematics education.

The last fundamental curriculum reform in Turkish mathematics and science education was initiated in 2004. The 2004 reform brought in several new instructional and assessment methods into the mathematics and science classrooms by emphasizing developmental processing skills (Argün, Arıkan & Bulut, 2010).

Through this reform, student-centred approaches, in accordance with activity-based teaching, were introduced into Turkish mathematics classrooms. Active engagement of students in the process of solving mathematics problems, identifying links to other subject areas, and gaining the learning experiences both inside and outside of the classroom were among the goals of the new mathematics and science curriculum (Güven & İşcan, 2006). These reforms gave importance to extending students' critical thinking skills in a way that they might easily solve real-life and authentic problems, as well as use information-communication technologies to enhance the implementation process (Koç, Işıksal &Bulut, 2007). Authentic assessment tasks in mathematics and science, such as portfolios, projects, and other performance-based tasks were introduced as critical aspects of assessing students' learning alongside of the traditional paper and pencil tests (Ayas, Aydın & Corlu, 2013). Mathematics teachers were encouraged to engage their students in real life applications by integrating computer and information technologies into their lessons (Argün, Arıkan & Bulut, 2010). The 2004 reforms aimed at the ambition to reach the educational standards set by top-achieving countries and encourage teachers to construct technological learning environments, in which students could freely share their own ideas in line with their own emotions, interests, skills, and beliefs.

Turkish teachers as agents of change

Teachers have traditionally been considered the most effective agents of change when new curricular reforms are introduced. There was a general consensus among stakeholders that the success of reforms in Turkey relied on increasing the number of highly-qualified teachers (Dönmez, 2009). Aligned with this argument, Teaching and Learning International Survey (TALIS) results showed that the need for qualified teachers in Turkey was twice as much as the other developed countries (Büyüköztürk, Altun &Yıldırm, 2010). Furthermore, Turkish mathematics teachers were less experienced and were provided with less professional development opportunities, when compared to their counterparts in other OECD countries (Corlu, Erdoğan & Sahin, 2011). There is an agreement among stakeholders that successful implementation of curricular reforms within Turkey depends on increasing the quality of teachers.

Teacher quality and teaching knowledge

Teacher quality has generally been determined through their knowledge in content, pedagogy, and teaching in their subject area. Influential organizations in Turkey and abroad have published several reports on teaching standards (National Council for Accreditation of Teacher Education, 2008). There was a large body of research determining the gold standards of teaching (Darling-Hammond & Youngs, 2002; International Baccalaureate Organization, 2013; Türk Eğitim Derneği, 2009). In contrast to the earlier understanding of teachers as content and pedagogy experts, Shulman (1986), several other prominent researchers) have emphasized that teaching knowledge was subject-specific (An, Kulm & Wu, 2004; Ball, Thames & Phelps, 2008; Hill, Blunk, Charalambous, Lewis, Phelps, Sleep, & Ball, 2008). The new paradigm in teaching knowledge focuses on teachers' subject-specific teaching knowledge.

The concept of pedagogical content knowledge (PCK) was first defined by Shulman (1986), who emphasized that there was a significant distinction between the roles of content and pedagogy within teaching. According to Shulman, the knowledge required for teachers to decide what to teach, how to teach, how to deal with misconceptions, and successfully explain those misconceptions to their students had to be at the core of teacher quality. The PCK construct was created at the intersection of content and pedagogy knowledge and it included (a) instructional tools such as representations, demonstrations, illustrations, or analogies; (b) instructional decisions, such as knowing students' thoughts about the difficulty level of the content, planning different teaching materials according to students' backgrounds and interests, or providing students with learning environments that would help them develop pedagogically and academically (Shulman, 1986). In Shulman's understanding of PCK, there was not a single best way to represent the content; therefore teachers need to be able to create alternative forms.

In a sequential study related to PCK, Shulman (1987) emphasized that the teacher quality assurance systems used to evaluate teaching performance or for hiring decisions were ineffective in selecting the best teachers. Shulman complained that assessment systems tested only the very basic skills: a small amount of content knowledge and a small amount of pedagogical knowledge. Teacher quality assurance systems, Shulman believed, were failing to assess teachers with respect to their performances in classroom contexts, including whether they were successful in addressing the individual needs of their students. Shulman suggested that classroom management knowledge, curriculum knowledge, and pedagogical content knowledge needed to be considered as well. Shulman proposed that pedagogical content knowledge could be used in hiring or performance-related decisions regarding teachers.

Some researchers focused on teacher educators because they believed that their conceptions on how PCK should have been implemented would influence prospective teachers. For example, in Fernàndez-Balboa and Stiehl's (1995) study using ten American educators, several components of PCK emerged from their data. Some of these categories were (a) knowledge about the subject matter; (b) knowledge about the students; (c) knowledge about instructional strategies; (d) knowledge about the teaching context; and (e) knowledge about one's teaching purpose. Several other sub categories were identified from this study, such as knowing students' backgrounds and prior learning, using the knowledge of students to prepare different types of instruction, and convincing students about the importance of the subject. Some researchers have developed and contributed new concepts to the PCK construct as an indicator of teacher quality.

Teaching knowledge for mathematics

Several researchers have studied PCK with respect to mathematics. A consensus was established among the leading scholars of the field that being able to foster a conceptual understanding of mathematics with a good command of procedures and facts was the most important attribute of being an effective mathematics teacher (An, Kulm & Wu, 2004; Ball, Thames & Phelps, 2008; Çataloğlu, 2006; Niess et. al., 2012; Shulman, 1986; Şahin & Adıgüzel, 2012). Supporting this argument, Ball and Bass (2002) focused on the relationship between mathematics teachers' quality of teaching and student learning. Researchers emphasized the importance of the *mathematical knowledge for teaching* by discussing the relationship between the way teachers taught and student understandings (Ball, Thames & Phelps, 2008; Hill et al., 2008). Researchers found that teachers with expert mathematical knowledge were not necessarily more effective in teaching mathematics. Knowing how to teach mathematics—having a solid PCK level, was agreed upon by researchers to play an important role in being an effective mathematics teacher.

Some researchers have studied PCK levels regarding mathematics teachers from an international perspective. An, Kulm, and Wu (2004) conducted their research using mathematics teachers to compare PCK of mathematics teachers in China and the United States. In their study, the researchers expressed their understanding of PCK in four competency levels: (a) building on student ideas in mathematics; (b) dealing with students' misconceptions; (c) providing active participation of students for a deeper mathematics learning; (d) promoting student thinking about mathematics. The researchers claimed that the emphasis on conceptual knowledge and procedural knowledge had to be in balance. They concluded that conceptual understanding of mathematics was essential; however, "procedural learning is an essential learning process for reinforcing understanding and achieving mathematical proficiency and is a necessary step for problem solving" (p. 169). In short, they believed that teachers needed to know how to promote conceptual understanding, procedural knowledge, and problem solving and also be experts in these areas themselves. Additional research has supported the views that an effective mathematics teacher should have developed both conceptual and procedural understanding of mathematics and should have been successful in facilitating these understandings.

The role of technology in teaching and learning mathematics

Many researchers have emphasized the importance of technology usage for mathematics learning and teaching (Alakoç, 2003; Handal, Campbell, Cavanagh, Petocz & Kelly, 2012; Mishra & Koehler, 2006; Timur, 2011). Özel, Yetkiner, and Capraro (2010) stressed the power of technology in modeling real-life phenomena. These researchers found that technology improved student performance and disposition by allowing teachers to focus on conceptual understanding of mathematics. In addition, empirical evidence has surfaced that integrating technology into mathematics education increased the quality of teaching and the learning of mathematics (Handal, Campbell, Cavanagh, Petoczand & Kelly, 2012). Similarly, the importance of using technology as a tool to deliver effective teaching was found to be more effective than using technological knowledge as an isolated and inert type of knowledge (Akkoç, Bingölbali & Özmantar, 2008). Therefore, integrating technology into classroom teaching and learning was critical for teachers to help students construct an in-depth and conceptual mathematical understanding.

Using technology to help students construct mathematical knowledge necessitated some serious investments. Administrators realized that Turkish schools needed to be equipped with a state-of-the art technological tools, including high-tech computers and smart boards (Baki, 1996; MoNE, 2012a). More seriously than the financial aspect of this investment, integrating computer technologies into school mathematics was known to progress slowly. Baki (2001) believed that there were two reasons behind this slow progress: (a) the challenges of embedding information technologies within the traditional instruction; (b) many teachers did not have the necessary experience, will or confidence to keep up with the speed of technological advances.

Baki (1996) stated that the change in mathematics curricula and educational delivery depended on teachers' knowledge of where, when, and how to use technology. Therefore, alongside with the financial investment, there needed to be an additional investment in teacher quality which was equally important.

There were some studies that have identified standards to guide teachers in deciding where, when, and how technology should be used and integrated into mathematics teaching. For example, the technology report of The Association of Mathematics Teacher Educators (AMTE) have been instrumental in setting these technology standards (Landry, 2010). One of the most important criteria was the confidence levels of teachers in using their knowledge of technology (Niess, 2006). Koehler and Mishra (2005) further developed these standards by combining knowledge of technology, knowledge of pedagogy, and content knowledge. They called this new construct Technological Pedagogical Content Knowledge (TPCK) (See Figure 1). The standards developed by AMTE have established the foundation of TPCK as a new theory.

Koehler and Mishra (2005) defined TPCK as a nexus of technology, pedagogy, and content knowledge. TPCK was also referred as the "*Total PACKage*" for teaching effectively with technology (Thompson & Mishra, 2007, p. 38). The notion of TPCK consisted of the body of knowledge that would help teachers represent the concepts using technology, choosing the best pedagogical and instructional techniques, and identifying the strengths, weaknesses, and misconceptions of students in order to better prepare them for the 21st century.

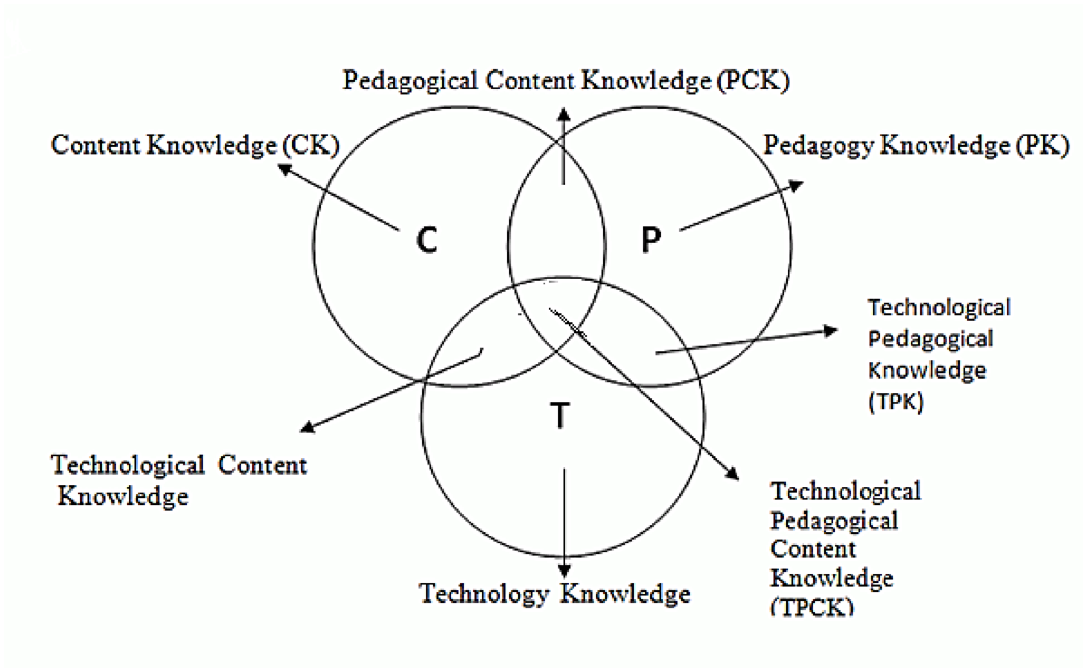

Figure 1. TPCK and PCK structure (Timur, 2011).

Teachers' self-confidence beliefs

Self-confidence was considered as a non-specific term or more of a colloquial used for the efficacy construct. The efficacy construct has been developed by Albert Bandura (1925, –) within the social cognitive theory. Bandura (1995) claimed that individuals' self-confidence in the task they were doing or in future tasks they would be doing increased their motivation and performance. According to social cognitive theory, efficacy was "not a global trait, but a differentiated set of self-beliefs linked to distinct realms of functioning" (Bandura, 2006, p. 307). The self-confidence concept has been considered as a non-specific term used for efficacy levels of individuals, which differed according to the domain of measurement.

The notion of teacher efficacy was defined specifically for in-service teachers' teaching domains. The conceptual framework related to teacher efficacy was deconstructed into two parts: self-efficacy and outcome expectancy (Corlu, 2012). In fact, Bandura explained that outcome expectancy was about individuals' estimations of the likely consequences (Bandura, 1986, as cited in Tschannen-Moran & Hoy, 2001), whereas self-efficacy was about teachers' confidence levels of their ability to teach their subject (Bursal, 2010; Enochs, Smith & Huinker, 2000). These researchers emphasized that teachers' efficacy levels affected the goals they set, the effort they made, and the level of their desire regarding teaching.

Despite many studies on the efficacy beliefs of pre-service teachers (e.g. gender was found to have no statistically significant effect on pre-service teachers' self-efficacy beliefs in Bursal, 2010; Cakiroglu, 2008; Cakiroglu, Cakiroglu & Boone, 2005), there was a limited number of studies specific to in-service teachers. In an international comparison study, Turkish teachers were found to be highly efficacious, similar to teachers in other OECD countries (OECD, 2009). Other researchers reached a similar conclusion for mathematics teachers from a secondary analysis of TALIS data (Corlu, Erdogan & Sahin, 2011). Literature on Turkish in-service mathematics teachers' efficacy beliefs was scarce.

Teachers' self-confidence levels in using technology in their daily lives was found to affect their teaching in the classroom (Christensen, 2002). Some scholars claimed that teachers' self-confidence beliefs were as important as their knowledge of technology or content knowledge for increasing student achievement (Tezci, 2010). In a research study utilizing Turkish pre-service teachers, researchers found that there was a positive correlation between familiarity with technology and teacher candidates' levels of self-confidence (Erdemir, Bakırcı & Eyduran, 2009). Roussos (2007) stated that the inadequacy of teachers' knowledge and skills of computer technologies harmed their self-confidence levels, which in turned resulted in higher anxiety levels. High anxiety was an inhibiting factor in their use of technology. The same research also found that higher levels of teachers' the self-confidence paralleled the frequency of technology integration in instruction.

Fatih Project

The Fatih Project is a nation-wide effort initiated by MoNE to provide equal opportunity for all students, thus, to improve the educational opportunities for both teachers and students across Turkey by equipping Turkish classrooms with the latest technology (MoNE, 2012a). The Turkish ministry is collaborating with The Scientific and Technological Research Council of Turkey in order to equip 570.000 classrooms in over 40.000 schools with the latest educational technologies (Informatics Association of Turkey, 2012). The main purpose of the Fatih Project is to introduce technology as an effective instructional tool in Turkish classrooms. This project aims to achieve goals in two perspectives: (a) equipment and software substructure and (b) professional development opportunities for teachers. After the initial phase, which is slated to be completed by 2014, the project will be widened across Turkey within the next four years (MoNE, 2012a).

There are five support systems within the Fatih Project. First, the improvement of technological infrastructure of Turkish schools—each classroom will be provided with Tablet PCs and interactive white boards. Second, providing and developing e-content and software—MoNE collaborates with The Scientific and Technologic Research Council of Turkey and universities to create new e-contents and software. Third, the professional development of the teachers (MoNE, 2012a). The fourth and fifth support systems are the effective usage of information-communication technology (ICT) tools and manageable and measurable ICT usage, which can be provided through the training programs (MoNE, 2012a).

The Fatih Project will bring along some changes in schools, especially in the classrooms. Within the project, authorities expressed that the hardware infrastructure will be enhanced, e-learning contents will be provided, and curricula will be converted to a newer version that includes information technologies (Çelen, Çelik & Seferoğlu, 2011). There are many studies which have explored the importance of these innovations that the Fatih Project will bring to Turkish classrooms.

Technological tools of the Fatih Project

Computer technology

Computers and software programs have been used to enhance traditional teaching for years. From old CD-ROMs and videodiscs to computers, technological tools allowed educators to visualize and model concepts in mathematics and to enhance the instructional process. These technologies have enabled the integration of rich visual materials such as graphics and animations, which have eased the successful attainment of instructional objectives (Weaver, 2000).

The integration of computers into the instructional process has improved students' academic achievement in mathematics (Weaver, 2000). Through different software applications, such as geometer's sketchpad (Purdy, 2000), GeoGebra (Antohe, 2011; Hohenwarter & Lavicza, 2009), virtual calculators, and other similar visualizing tools (Selçik & Bilgici, 2011), students were found to spend less time on procedures and more time on conceptual understanding in an engaging way (Özel, Yetkiner & Capraro, 2010). With internet access, computer technologies have allowed both students and teachers to reach the needed useful information related to mathematics.

Tablet PCs

Tablet PCs have been essential for teachers to facilitate mathematical thinking and reasoning. Scholars have claimed that Tablet PCs enhanced the opportunities of traditional computers and electronic boards (Mitchell, 2007). Other researchers have found that tablet PCs assisted teachers with ease of marking-up, editing, or writing directly on the screen, drawing geometrical shapes and graphs, changing handwriting into text with a click of a pen (Hulls, 2005). There has been a consensus on the usefulness of Tablet PCs in helping teacher with better use of their time and in increasing the instructional quality of their teaching (Mitchell, 2007).

Students could also benefit from the use of Tablet PCs in the classroom. Some of the uses could be taking notes and sharing these notes with their classmates as well as drawing geometrical shapes or algebraic graphs. Research showed that Tablet PCs were a time-saver for students so that they could concentrate on the content presented rather than spending time on note taking using traditional methods (Romney, 2010). Tablet PCs have provided students with a better learning environment.

Interactive white boards

Many research studies have emphasized the importance of using interactive white boards in classroom instruction. Research stated that interactive white boards had the potential to address students' different learning styles and to work as a motivational tool (Beeland, 2002). In an action research study conducted with middle grades students, researchers found that using interactive white boards in the classroom increased student engagement. Researchers concluded that visual representation of concepts could be the reason to explain high student engagement (Beeland, 2002). Özel, Yetkiner and Capraro (2010) stated that interactive white boards gave teachers several opportunities to design enjoyable and effective teaching materials, which resulted in enhanced student understanding. It was also pointed out that interactive white boards made the process of preparing lesson plans easier and less-time consuming when compared to traditional black boards (Glover, Miller, Averis, & Door, 2005).

Presentation tools

Presentation tools have assisted teachers in preparing teaching materials in advance and allow easy changes when necessary. Teachers can save their presentations and make changes as necessary instead of recreating the same teaching material for every teaching lesson (Kennevell, 2005). Research was conducted using 111 participants to find out the barriers of using presentation tools as a part of information communication technologies (ICT) in the classroom (Keong, Horani & Danie, 2005). The identified barriers of using ICT tools were: lack of time, unsatisfactory teacher training opportunities, poor technical support, lack of knowledge about how to integrate ICT to improve instruction, struggling with integrating different ICT tools in one lesson, and inaccessibility of resources at home for the students. This research requires teacher training programs to overcome the barriers as the Fatih Project proposed.

In the process of implementing the Fatih Project, because the main implementers are the teachers, they hold the biggest responsibility (Aktaş, Özmen & Bilgin, 2012; Kayaduman, Sırakaya & Seferoğlu, 2011). Turkish teachers should be ready for the challenges that come along with the Fatih Project which is the most ambitious project in Turkish educational history. For an effective sustainable project, there should be professional training programs—which are one of the support systems of the project— for teachers to encourage their active participation (Akıncı, Kurtoğlu & Seferoğlu, 2012).

What is special about specialized schools?

Specialized schools (e.g., anatolian schools, science schools, social science schools, teacher schools, police and military academies) select their students and teachers through selective and competitive national examinations. These schools prepare students for the top ranked higher education institutions in Turkey or abroad. Specialized schools offer a higher quality of education for only a limited number of selected students (Özel, Yetkiner, Capraro & Küpçü, 2009). The students, who attend these specialized schools, have performed above the national average score on the PISA study and met the international standards of OECD (Alacaci & Erbas, 2010; Berberoğlu & Kalender, 2005). One of the reasons for the success behind these schools were tied to the strength of their mathematics and science programs which involve more advanced topics with a greater number of instructional hours (Corlu, 2012; MoNE, 2013b). Teacher quality could also be another reason to explain student success at these schools. In fact, MoNE hires specialized school teachers who have at least three-years experience and who perform well on a content-based standardized selection test (Gür & Çelik, 2009; Özoğlu, 2010).

Teacher education system in Turkey

The process of becoming a teacher in Turkey begins in high school. Teacher high schools aim to prepare students for faculties of education. In addition to their well-rounded education as future teachers, students of these schools are awarded with extra credit to ease their transition to faculties of education (Gürşimşek, Kaptan & Erkan, 1997, cf. MoNE, 2012c). This positive discrimination for teacher high school graduates makes it almost impossible for other high school graduates to become teachers through faculties of education (Gürşimşek, Kaptan & Erkan, 1997).

According to MoNE (2012d), only graduates of faculties of education can be employed as teachers in the public school system. However, an alternate path exists for graduates of faculties of arts and sciences, who are trained as scientists rather than teachers, through pedagogical formation programs (See Figure 2). This alternate path is popular due to the high unemployment rates of graduates of faculties of arts and sciences (Özoğlu, 2010). In most cases, these formation programs are inadequate to well-prepare teacher candidates for the teaching profession (Corlu & Corlu, 2010).

Until recently, teacher candidates from both faculties of education and faculties of arts and sciences had to sit the outdated Public Personnel Selection Examination (PPSE). The old PPSE consisted of two sections where the first section measured teacher candidates' general knowledge and skills, which included questions from history, geography, citizenship, Turkish, and elementary mathematics. Teacher candidates were given 120 minutes to solve 120 multiple choice questions. The second section measured teacher candidates' pedagogy knowledge (PK). This session included 120 questions to be solved in 150 minutes (Eraslan, 2004; Student Selection and Placement Center [SSPC], 2012b). Many educators and teacher educators criticized the fact that all teacher candidates, regardless of their specialty, had to solve the very same questions (Eraslan, 2004).

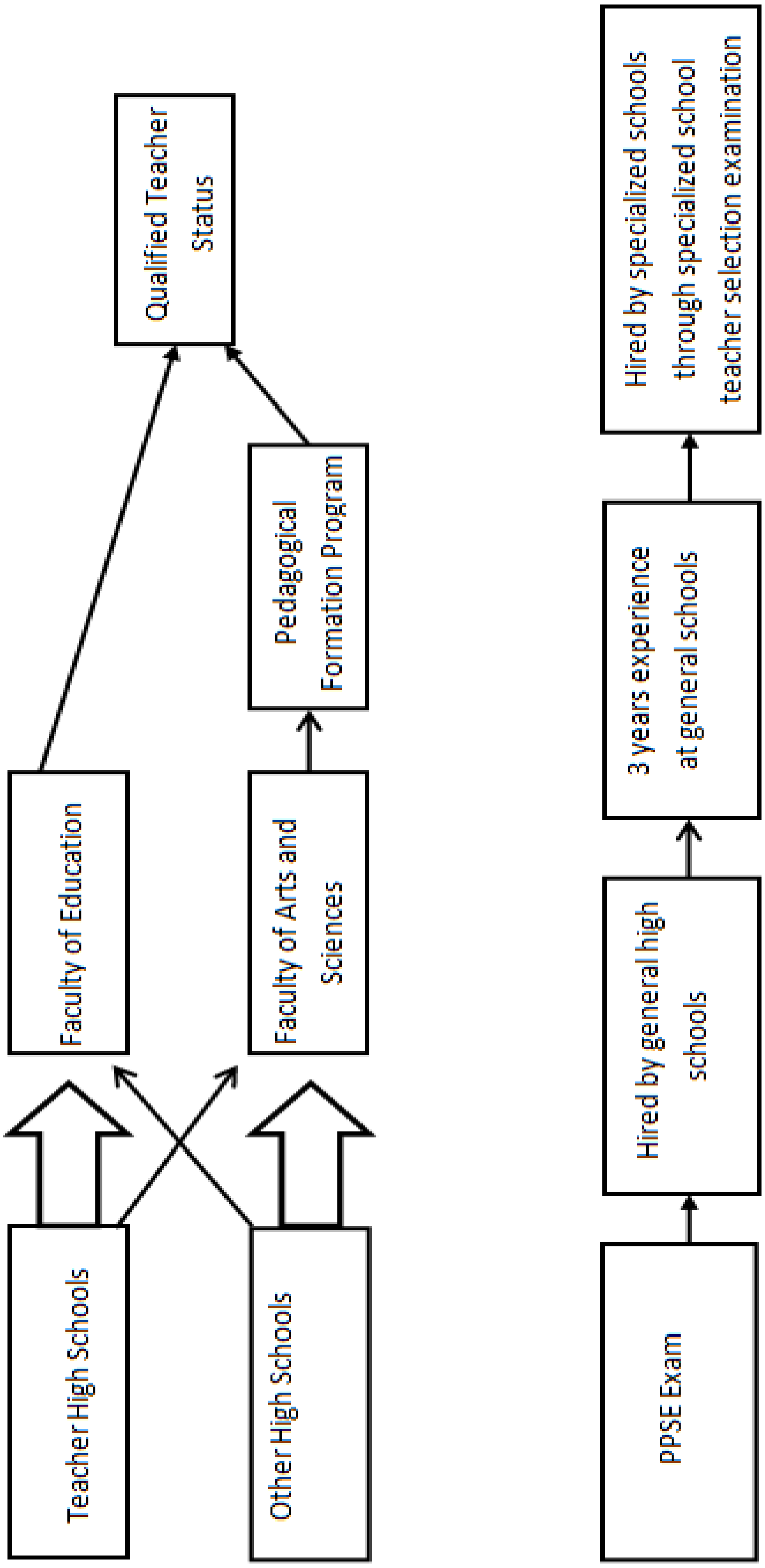

Figure 2. The path for becoming a specialized high school teacher

Policy makers recently decided that subject-specific tests would be needed in order to select the best teachers in each subject area (Kılıçkaya & Krajka, 2013). The new PPSE, effective from 2013, is slated to include four sections: general knowledge, pedagogy knowledge, subject-specific content knowledge, and subject-specific pedagogical-content knowledge. The subject-specific content knowledge test is planned to include advanced mathematics content questions, while some additional questions have been planned to be added to measure teacher candidates' subject-specific pedagogical-content knowledge (See Figure 3 for sample questions). The reason behind this change in the PPSE examination system was to employ teachers who were skilled in their subject knowledge and knew how to teach the concepts and address the misconceptions of students.

Bir öğretmen, öğrencilerine "Bir noktada türevlenebilen bir fonksiyonun, o noktada sürekli olduğunu" belirtmiştir. Buna örnek olarak da $f : R \to [-1,1]$ olmak üzere

$f(x) = \sin x$ fonksiyonunun $x = \frac{\pi}{2}$ noktasında türevli ve sürekli olduğunu göstermiştir.

Bir öğrenci; bu önermenin karşıtının da doğru olduğunu, $f(x) = \sin x$ fonksiyonunun $x = 0$ noktasında sürekli olduğunu ve dolayısıyla bu noktada türevlenebildiğini ifade etmiştir.

Buna göre, öğrencide oluşan bu kavram yanılgısını gidermek için öğretmenin aşağıdakilerden hangisini yapması gerekir?

A) Öğrenciye, düşüncesinin yanlış olduğunu ve verilen önermeyi tekrar incelemesi gerektiğini belirtmesi

B) Öğrenciye, bir noktada türevli olan bir fonksiyonun o noktada sürekli de olduğunu daha fazla örnek üzerinde göstermesi

C) Öğrenciye, bir noktada sürekli olan ancak o noktada türevlenebilir olmayan bir örnek vermesi

D) Öğrenciye, limit konusunda yanılgıları olduğunu ve öncelikle bu konuya çalışması gerektiğini belirtmesi

E) Öğrencinin, türevin geometrik anlamı ile ilgili örnekler üzerinde çalışmasını istemesi

Gerçel sayılar kümesi üzerinde bir f fonksiyonu

$$f\left(\frac{x}{2}\right) = \frac{x^2}{4} + x + 1$$

biçiminde tanımlanıyor.

Buna göre, $f(a) = 0$ eşitliğini sağlayan a değeri kaçtır?

A) $\frac{1}{2}$ B) $\frac{3}{2}$ C) $\frac{-1}{4}$

D) -1 E) -3

Figure 3. Sample PPSE questions for mathematics teachers (SSPC, 2012a).

Becoming a mathematics teacher in a specialized high school required other qualities such as having three years teaching experience and being successful on the *Specialized Schools Teacher Selection Exam* (SSTSE) (MoNE, 2010). This test measures only the subject specific content knowledge (See Figure 4 for sample questions). Some researchers claimed that teachers' PCK should be tested, as well (Corlu, 2012).

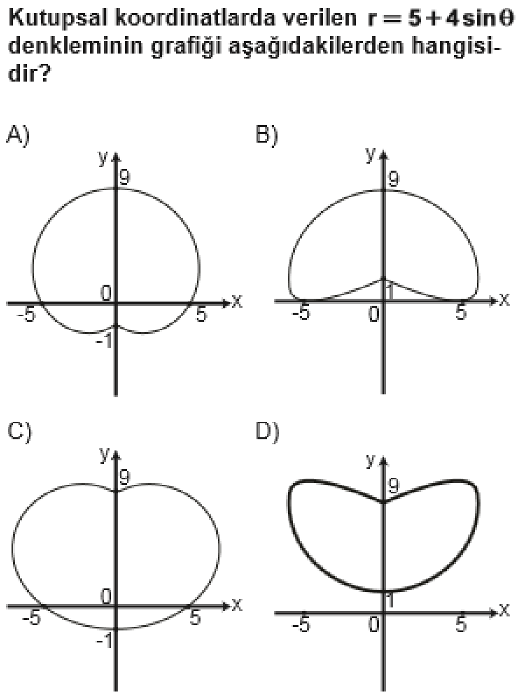

Figure 4. A sample question from 2012 SSTSE.

CHAPTER 3: METHOD

This current research investigates the relationship between the Technological Pedagogical Content Knowledge (TPCK) self confidence levels of Turkish mathematics teachers (dependent variable) and the schools where they work: general and specialized high schools (independent variable). In this Chapter, the research design used to address this research question, the pilot study, participants and how they were sampled, data collection, and data analysis were explained.

Research design

A non-experimental quantitative research design was used in the current study. In non-experimental quantitative research, the researcher identifies the variables and looks for relationships without manipulating the data (Pagano, 2010). In quantitative research, the researcher raises a hypothesis, tests this hypothesis, and generalizes the results to a larger population (Arghode, 2012). Figure 5 shows the quantitative research steps followed in this current study based on the framework outlined by Mertens (2005) .

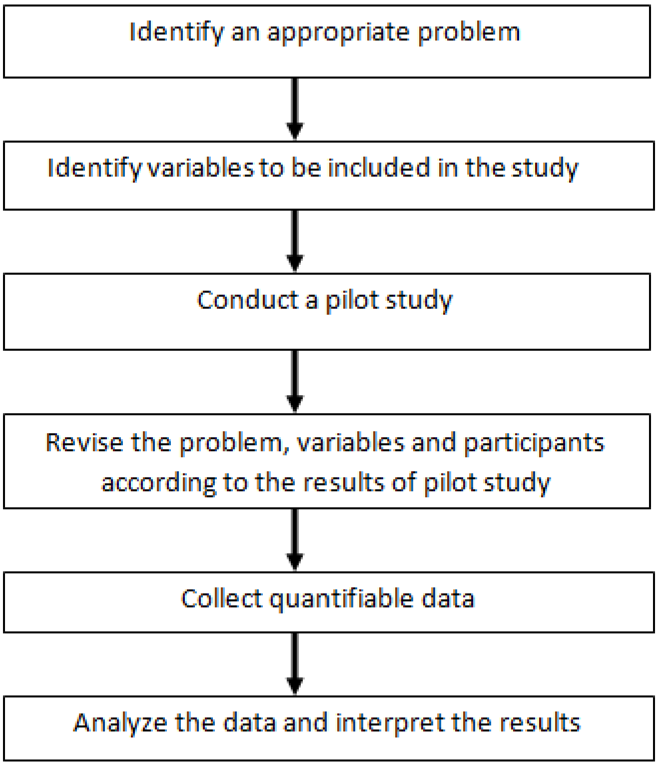

Figure 5. Steps followed to conduct current research (Figure was drawn by the current researcher according to Mertens, 2005, p. 155).

In fact, the nine step version of hypothesis testing was followed in the current study (Huck, 2011):

1. State the null hypothesis,
2. State the alternative hypothesis,
3. Specify the desired level of significance,
4. Specify the minimally important effect size,
5. Specify the desired level of power,
6. Determine the proper size of the sample(s),
7. Collect and analyze the sample data,
8. Refer to a criterion for assessing the sample evidence,

9. Make a decision to discard/retain.

Pilot study

A pilot study with pre-service teachers was conducted for a variety of reasons: (a) to finalize the research questions and research plan; (b) as a training for the researcher in the research process; (c) to determine the required sample size through a power analysis; (d) to improve the quality of the survey items; (e) to improve the efficiency of the survey logistics (time, response rate, budget, etc.) (Cohen, Manion & Morrison, 2005).

The pilot study was conducted with 16 pre-service mathematics teachers. The study included a survey, which was administrated online through a software called Qualtrics. The online system allowed the researcher to test the feasibility of the Likert type survey as well as to have feedback on the efficiency of the design process.

The lowest Cronbach's *alpha* coefficient in the pilot data was .87, indicating a strong estimate of internal consistency (Tavakol & Dennick, 2011). The time given to participants to complete the survey (20 minutes) was evaluated as adequate. The participants responded positively to the wording of the survey. In fact, 80% of the participants could see no problem in the way that the items were phrased. However, some minor modifications were applied according to their feedback. The online survey helped the researcher to stay within the planned budget of the overall project. The low response rate obtained from the pilot study necessitated a face to face administration of the actual survey. The researcher planned to finish data collection in a month.

The researcher benefitted from the pilot study in terms of gaining experience in conducting empirical research, as well as finalizing the research questions of this study. After the initial investigation of data from the pilot study, the researcher came to the conclusion that the teacher certification type (through faculties of education or faculties of arts and sciences) does not constitute a noteworthy variable. Therefore, the school type was kept as the only independent variable in explaining the variance in TPCK self-confidence levels of in-service mathematics teachers.

One of the most important benefits of conducting a pilot study was to determine the required sample size for the actual study (Teijlingen & Hundley, 2001). When the means and the standard deviations were entered into a special software named G*Power3, the program estimated an effect size—strength of a reported relationship—(Cohen's *d*) of 1.23. Thus, the required sample size was 58 in order to be 99% sure ($\alpha = 0.05$) that there would be a statistically significant difference between different school types.

Participants

The research was conducted with 40 mathematics teachers working at 10 different high schools in the Çankaya district of Ankara, Turkey. All high schools in the Çankaya district were divided into two groups to use the stratified sampling method: specialized high schools ($n = 26$) and general high schools ($n = 14$). Among all schools, 5 schools from each group were randomly chosen. In total, 10 high schools were evaluated as adequate to provide the researcher with the minimum number of teachers as the required sample size. Table 1 presents that the response rate was 66.6% for specialized high school teachers and 35% for general high school teachers, indicating an overall 51% response rate.

Table 1
Response rate for schools

	Number of total teachers	Respondent number	Response rate
Specialized high schools	39	26	66.60%
General high schools	40	14	35%

Schools' websites helped the researcher in determining the number of mathematics teachers at each school. All mathematics teachers in these schools were invited to complete the survey. However, participation in this research project was based on volunteerism. See Table 2 for gender distribution of the participants.

Table 2
Gender distribution of participants

	Male	Female	Percentage	Total
Specialized high schools	13	13	65%	26
General high schools	6	8	35%	14
Total	19	21	100%	40

Table 2 shows that out of the 40 mathematics teachers, 19 of them were male and 21 of them were female. Male and female teacher ratios were approximately equal in both groups. See Table 3 for age distribution of the participants.

Table 3
Age distribution of participants

	30-39	40-49	50-59	60 and older	Total
Specialized high schools	4	17	5	0	26
General high schools	1	10	3	0	14
Total	5	27	8	0	40

Participants' ages were between 30 and 59. Although the sample included both experienced and novice teachers, the median age for both groups was in the 40-49 range. See Table 4 for highest graduation degrees of teachers.

Table 4
Last graduation degrees of participants

	Bachelor's Degree	Advanced Degree	Total
Specialized high schools	20	6	26
General high schools	13	1	14
Total	33	7	40

For both specialized and general high schools, only a few teachers had advanced degrees (master’s or doctorate). Teachers with advanced degrees were mostly from specialized high schools. See Table 5 for total teaching years of teachers in the sample.

Table 5
Teaching experience of participants

	0-10	11-20	21-30	31-40
Specialized high schools	0	14	12	0
General high schools	0	4	8	2
Total	0	18	20	2

All teachers in the sample could be categorized as experienced teachers. There were no teachers with less than 10 years of teaching experience. See Table 6 for the percentages of mathematics teachers that personally possessed the Fatih Project technologies.

Table 6
Percents of teachers with access to Fatih Project technologies at home

	Personal Computer	Personal Tablet	TI Graphics Calculator
Specialized high schools	85%	35%	12%
General high schools	86%	14%	21%
Total	83%	25%	13%

The majority of teachers in both school types possessed their own personal computers. Technologies, such as tablet PCs (25%) or TI Graphing Calculators (13%) were rarely possessed by the teachers. Only 8% of the teachers had advanced mathematical programs in their computers. This commonality was observed for both groups. See Table 7 for percentages of teachers who had access to technological tools at their schools.

Table 7
Percents of teachers with access to Fatih Project technologies at school

	Computer in class	Computer in teachers' room	Projector	Smart board	Tablet PC in class
Specialized high schools	58%	0%	12%	62%	12%
General high schools	7%	14%	0%	86%	0%
Total	43%	5%	8%	70%	8%

The majority of teachers in both school types had access to smart boards. However, only half of the teachers had access to computers in their classrooms. In fact, the researcher observed that in some schools, the smart board was used in the teachers' lounge as a practicing tool or was used for entertainment purposes. Table 7 shows that there might be a negative relationship between the number of old-school projectors and smart boards, indicating that the Fatih Project technologies were replacing existing technologies at both schools. Teachers' knowledge about the project varied: 64% of general and 62% of specialized high school mathematics teachers knew about the Fatih Project.

Instrumentation

The instrument consisted of 31 items, which were grouped theoretically under four measures: TPCK (8 items), TPK (7 items), TCK (5 items), and TK (11 items) (See Appendix 1). The instrument was an adaptation of the TPCK confidence survey (Graham, Burgoyne, Cantrell, Smith, & Harris, 2009), which was translated into Turkish by Timur (2011) (See Appendix 2 for written permission of author). The confirmatory factor analysis in a similar context to the present study showed that a four-factor model fit data well (Timur & Tasar, 2011). The modifications for the current study was limited to rewording of the items in order to specifically address the self-confidence levels of mathematics teachers in using technologies within the Fatih Project.

All positively worded five-point Likert-type scale (strongly confident = 4, confident = 3, neutral = 2, unconfident = 1, and strongly unconfident = 0) was used. Thus, the score range for dependent variable was 0 to 4, individual scores of the participants were calculated by averaging the responses in each measure.

Data collection

Data was collected using a face to face survey in Turkish, because surveys are relatively less expensive than other research methods, they can be conducted from remote location, the number of questions asked can be relatively more than others, obtaining high score reliability is possible, large samples can be reached, and data can be collected rapidly (Creswell, 2003). All participants were informed that they were not obliged to complete the survey and that they could withdraw whenever they wanted. The permission from MoNE was provided to school administration before talking with the teachers about the survey (See Appendix 3).

In order to collect data, the researcher went all ten schools, introduced herself and her thesis, showed permission from MoNE, and requested meeting with mathematics teachers. Some schools' principals allowed meeting with them, some of them did not. Although the permissions from MoNE and the school principal, some teachers did not want to complete the survey. Ultimately, data were collected at one point in time from the representative sample which was 40 mathematics teachers from randomly selected high schools.

Reliability and validity

The score reliability was estimated using Cronbach's *alpha*, because Cronbach's *alpha* is one of the most commonly used methods in reliability analysis. Cronbach's *alpha* coefficients as a measure of international consistency of scores were estimated for each measure (Tavakol & Dennick, 2011). The Cronbach's *alpha* coefficients for TPCK, TPK, TCK, and TK scales were .91, .88, .89, and .90, respectively. High *alpha* coefficients indicated a high internal consistency of the scores (Bryman & Cramer, 1997). The results were also consistent with the pilot study and Timur (2011), who estimated the lowest Cronbach's *alpha* coefficient as .86 in a study with pre-service Turkish science teachers.

Corrected item-total correlations between the scales and Cronbach’s *alpha* values when a certain item deleted, were estimated respectively to measure the consistency among the items and to see the effect of removing these items from each measure. The corrected item-total correlation was "an indication of the degree to which each item correlates with the total score" (Pallant, 2001, p.92). The items with values less than .30 were considered as irrelevant to the measure. Pallant (2001) stated that small values showed the item was measuring something different from what the scale was measuring as a whole. See Table 8, 9, 10 and 11 for the corrected item-total correlations and Cronbach's *alpha* when any item was deleted for all four scales.

Table 8
Item-total statistics of TPCK scale

Items of TPCK	Corrected Item-Total Correlation	Cronbach's *alpha* if Item Deleted
TPCK1	.63	.91
TPCK2	.58	.91
TPCK3	.79	.89
TPCK4	.80	.89
TPCK5	.77	.89
TPCK6	.76	.90
TPCK7	.64	.91
TPCK8	.72	.90

Table 9
Item-total statistics for TPK scale

Items of TPK	Corrected Item-Total Correlation	Cronbach's *alpha* if Item Deleted
TPK1	.73	.86
TPK2	.65	.87
TPK3	.66	.87
TPK4	.81	.85
TPK5	.73	.86
TPK6	.66	.87
TPK7	.47	.89

Table 10
Item-total statistics for TCK scale

Items of TCK	Corrected Item-Total Correlation	Cronbach's *alpha* if Item Deleted
TCK1	.60	.90
TCK2	.79	.86
TCK3	.89	.83
TCK4	.69	.88
TCK5	.74	.87

Table 11
Item-total statistics for TK scale

Items of TK	Corrected Item-Total Correlation	Cronbach's *alpha* if Item Deleted
TK1	.59	.90
TK2	.48	.90
TK3	.64	.89
TK4	.69	.89
TK5	.60	.89
TK6	.71	.89
TK7	.80	.88
TK8	.68	.89
TK9	.73	.89
TK10	.57	.90
TK11	.53	.90

In all four scales of the current survey, there were no corrected item-total correlation values less than .30, meaning that all items were measuring similar constructs (Pallant, 2001). Thus, there was no need to remove any of the items in any of the four scales.

In addition to the validity evidence based on the pilot study and the expert views of a mathematics education professor, the upper limits of validity was estimated by the square root of the Cronbach's *alpha* coefficients as .95 (*TPCK*), .94 (*TPK*), .94 (*TCK*), and .95 (*TK*) (Angoff, 1988).

Data analysis

Data were first explored with respect to normality and outliers. Any violations were checked by means of graphical and statistical measures, such as histograms, standardized scores, skewness, and kurtosis (Tabachnick & Fidell, 2007). No outliers or missing scores were detected.

The analyses of data were conducted by using Statistical Package for the Social Sciences (SPSS) 15.0. The study employed descriptive statistical methods to draw an outline of participants' self-confidence levels. After gathering the data, the points on Likert scale were calculated for each participant. Because all the questions included in the Likert scale were positively stated, the points that teachers gained for each question were coded as 0, 1, 2, 3, and 4 (0 for strongly unconfident, 1 for unconfident, 2 for neutral, 3 for confident, 4 for strongly confident). Data were analyzed at the item level using the Mann-Whitney non-parametric test. Effect sizes at the item-level were first estimated with the help of the formula $r = z/\sqrt{n}$, which was later converted to Cohen's *d* for an easier interpretation (DeCoster, 2009).

Bivariate correlations were estimated between each pairs of factors with Pearson's product-moment correlation coefficient *r*. An independent *t*-test was conducted to answer the research question. Effect sizes at the factor-level were estimated in score-world statistics with Cohen's *d*. Effect sizes were reported, regardless of whether a statistically significance was observed or not, to allow fellow researchers to keep informed on practical significance of their results. A post-hoc power analysis was conducted only when a statistical significance was not observed (Thompson, 2008).

As Huck (2011) explained in the nine step hypothesis testing, first null and alternative hypotheses were stated. Second, level of significance ($\alpha = .05$), effect size ($d = 1.23$), level of power ($1-\beta = .99$), and sample size ($n = 58$) were specified. Then, through hypothesis testing, the means and standard deviations of selective high school mathematics teachers' TPCK self confidence levels were compared with the means and standard deviations of general high school mathematics teachers' TPCK self confidence levels.

Chapter 4: RESULTS

Descriptive statistics

The findings of this study included the presentation of descriptive statistics at both item and factor levels. Table 12 and Table 13 present the percentages of each response at item level, including median, mode, and range values for the ordinal item-level data in order to have a better understanding of how the participants responded to each item in the survey, overall.

Table 12

Percent distribution of participants' responses to each item

	Strongly Unconfident		Unconfident		Neutral		Confident		Strongly confident	
	SS*	GS**	SS	GS	SS	GS	SS	GS	SS	GS
TPCK1	11.5	0	3.8	7.1	26.9	42.9	50	50	7.7	0
TPCK2	0	7.1	19.2	7.1	38.5	28.6	38.5	57.1	3.8	0
TPCK3	0	0	23.1	7.1	26.9	28.6	38.5	64.3	11.5	0
TPCK4	0	0	19.2	14.3	11.5	14.3	61.5	71.4	7.7	0
TPCK5	3.8	0	11.5	7.7	19.2	7.7	53.8	69.2	11.5	15.4
TPCK6	3.8	0	11.5	0	15.4	30.8	65.4	46.2	3.8	23.1
TPCK7	0	0	15.4	7.7	26.9	38.5	53.8	53.8	3.8	0
TPCK8	0	0	15.4	7.7	26.9	30.8	53.8	53.8	3.8	7.7
TPK1	7.7	0	3.8	0	30.8	61.5	46.2	30.8	11.5	7.7
TPK2	3.8	7.7	11.5	23.1	30.8	23.1	42.3	46.2	11.5	0
TPK3	7.7	0	3.8	16.7	38.5	25	46.2	58.3	3.8	0
TPK4	3.8	8.3	3.8	0	30.8	50	53.8	41.7	7.7	0
TPK5	3.8	0	0	0	26.9	16.7	57.7	75	11.5	8.3
TPK6	3.8	0	7.7	8.3	42.3	50	46.2	41.7	0	0
TPK7	0	0	7.7	8.3	46.2	58.3	42.3	25	3.8	8.3
TCK1	0	0	15.4	16.7	26.9	41.7	50	41.7	7.7	0
TCK2	3.8	0	7.7	16.7	34.6	25	46.2	58.3	7.7	0
TCK3	3.8	0	7.7	16.7	26.9	25	50	58.3	11.5	0
TCK4	0	0	11.5	0	11.5	33.3	57.7	66.7	19.2	0
TCK5	7.7	0	7.7	0	15.4	50	50	33.3	19.2	16.7
TK1	7.7	0	3.8	8.3	15.4	58.3	61.5	33.3	11.5	0
TK2	0	0	3.8	8.3	26.9	25	50	66.7	19.2	0
TK3	0	0	7.7	8.3	7.7	16.7	57.7	75	26.9	0
TK4	7.7	0	0	16.7	23.1	41.7	53.8	41.7	15.4	0
TK5	3.8	0	7.7	16.7	15.4	58.3	65.4	25	7.7	0
TK6	3.8	8.3	7.7	8.3	38.5	58.3	42.3	16.7	7.7	8.3
TK7	3.8	8.3	11.5	16.7	30.8	50	42.3	16.7	11.5	8.3
TK8	0	8.3	7.7	16.7	19.2	25	57.7	41.7	15.4	8.3
TK9	7.7	8.3	11.5	16.7	23.1	41.7	50	25	7.7	8.3
TK10	19.2	16.7	23.1	25	34.6	16.7	23.1	33.3	0	8.3
TK11	15.4	0	26.9	25	30.8	25	26.9	50	0	0

Note. *SS stands for the specialized high schools. **GS stands for the general high schools. TPCK: Technological pedagogical content knowledge. TPK: Technological pedagogical knowledge. TCK: Technological content knowledge. TK: Technological knowledge.

Table 13
Item level location statistics

	Median	Mode	Range
TPCK1	3.00	3	4
TPCK2	2.00	3	4
TPCK3	3.00	3	3
TPCK4	3.00	3	3
TPCK5	3.00	3	4
TPCK6	3.00	3	4
TPCK7	3.00	3	3
TPCK8	3.00	3	3
TPK1	3.00	2[†]	4
TPK2	3.00	3	4
TPK3	3.00	3	4
TPK4	3.00	3	4
TPK5	3.00	3	4
TPK6	2.00	2[†]	3
TPK7	2.00	2	3
TCK1	3.00	3	3
TCK2	3.00	3	4
TCK3	3.00	3	4
TCK4	3.00	3	3
TCK5	3.00	3	4
TK1	3.00	3	4
TK2	3.00	3	3
TK3	3.00	3	3
TK4	3.00	3	4
TK5	3.00	3	4
TK6	2.00	2	4
TK7	2.00	2	4
TK8	3.00	3	4
TK9	2.50	3	4
TK10	2.00	2	4
TK11	2.00	3	3

Note. [†] Multiple modes exist. The smallest value was shown. TPCK: Technological pedagogical content knowledge. TPK: Technological pedagogical knowledge. TCK: Technological content knowledge. TK: Technological knowledge.

The location of data for the overwhelming majority of items was centred around a mode of 3, indicating that mathematics teachers in the sample were generally confident about using their TPCK, TCK, TPK, and TK within the context of the Fatih Project. However, the range values, which were used as measures of data dispersion, were quite large.

The first and main research question was: "Is there a statistically significant difference between TPCK self-confidence levels of general high school mathematics teachers and specialized high school mathematics teachers for teaching in the Fatih Project?" In order to answer the first research question, a non-parametric two-sample Mann-Whitney test was conducted. The test was used to test statistically significant difference between the mean ranks of two independent samples—the self-confidence levels of general and specialized high school mathematics teachers (Cohen, Manion & Morrison, 2005). Table 14 presents the mean ranks, which were used to test the null hypothesis of a statistically significant difference between the samples. The Mann-Whitney test compared mean ranks with critical *U* values. The number in the asymptotic significance column, which indicated the probability *p* value, helped to reject or retain the null hypothesis by considering its relative greatness in contrast to a pre-determined *alpha* value ($\alpha = .05$) (Huck, 2011).

Table 14
The Mann-Whitney test statistics for each item

	Mann-Whitney U	Z	Asymp. Sig. (2-tailed)
TPCK1	171.00	-0.34	.73
TPCK2	161.50	-0.63	.53
TPCK3	161.00	-0.64	.52
TPCK4	178.00	-0.13	.89
TPCK5	136.00	-1.11	.27
TPCK6	138.50	-1.03	.31
TPCK7	165.50	-0.12	.91
TPCK8	154.50	-0.48	.63
TPK1	148.50	-0.66	.51
TPK2	137.00	-1.01	.31
TPK3	150.00	-0.21	.84
TPK4	121.50	-1.19	.23
TPK5	139.00	-0.62	.53
TPK6	153.00	-0.10	.92
TPK7	141.00	-0.52	.60
TCK1	129.00	-0.92	.36
TCK2	152.50	-0.12	.91
TCK3	139.00	-0.58	.56
TCK4	126.00	-1.07	.28
TCK5	141.00	-0.50	.62
TK1	97.50	-2.02	.04
TK2	130.00	-0.91	.37
TK3	110.50	-1.66	.10
TK4	104.00	-1.77	.08
TK5	85.50	-2.43	.02
TK6	120.50	-1.20	.23
TK7	113.00	-1.42	.16
TK8	112.00	-1.51	.13
TK9	125.50	-1.01	.31
TK10	134.00	-0.71	.48
TK11	109.50	-1.53	.13

Note. TPCK: Technological pedagogical content knowledge. TPK: Technological pedagogical knowledge. TCK: Technological content knowledge. TK: Technological knowledge.

There was a statistically significant difference in two items between the self-confidence mean rank scores of general and specialized school teachers. The results of the non-parametric two-sample Mann-Whitney *U* test showed that specialized high school teachers' mean rank scores were statistically significantly higher than general high school teachers' mean rank scores in both items. Both items were in the TK domain: *saving pictures and applications in tablet PCs from an internet page* (TK1 with $z = -2.02$, $p = .04$) and *constructing a document which includes text and graphs in tablet PCs* (TK5 with $z = -2.43$, $p = .02$).

The effect sizes ($r = .32$; Cohen’s $d = 0.68$ and $r = .38$; Cohen’s $d = 0.82$, respectively for TK1 and TK5) were considered to indicate a practical difference when they were compared to Timur’s (2011) smallest effect size in an intervention study (eta-squared = 0.13 or Cohen’s $d = .77$).

Major findings

Table 15 shows the means and standard deviations of scores in each factor separately for both groups.

Table 15
Mean and standard deviations in each factor

	TPCK		TPK		TCK		TK	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
Specialized high schools	2.46	0.72	2.48	0.72	2.61	0.81	2.48	0.64
General high schools	2.54	0.68	2.43	0.49	2.48	0.57	2.22	0.75

Note. $\bar{x}$ indicates *mean*, SD indicates *standard deviation.* TPCK: Technological pedagogical content knowledge. TPK: Technological pedagogical knowledge. TCK: Technological content knowledge. TK: Technological knowledge.

The highest mean score for specialized teachers was in the TCK domain, indicating that specialized school teachers were most confident in their mathematics content knowledge when they had to use Fatih Project technologies. General school teachers were most confident in their TPCK and they were least confident in their TK. Standard deviations were between 0.49 and 0.75. See Table 16 for bivariate correlations between each continuous variables.

Table 16
Correlations between continuous variables

	TPCK	TPK	TCK	TK
TPCK	1	.47**	.77**	.44**
TPK		1	.58**	.34*
TCK			1	.50**
TK				1

* Correlation is statistically significant at the 0.05 level (2-tailed). **Correlation is statistically significant at the 0.01 level (2-tailed).

All pairs of correlations were significant at $p < .05$ level and were evaluated moderately strong, indicating that all factors were measuring related but not identical constructs. The strongest correlation was observed between the TPCK and TCK scores, indicating that teachers were associating their content knowledge with their pedagogical content knowledge when technology was considered. In the technology domain, pedagogy was not as strongly correlated with pedagogical content knowledge as content was.

In order to answer the four research questions of the present study, an independent *t*-test was used. Based on the results of the independent *t*-test (See Table 17), the differences between general and specialized school teachers' scores were not statistically significant for *TPCK* ($t[39] = -0.37$, $p > .05$; Cohen's $d = 0.12$), *TPK* ($t[39] = 0.22$, $p > .05$; Cohen's $d = 0.08$), *TCK* ($t[39] = 0.48$, $p > .05$; Cohen's $d = 0.18$), *TK* ($t[39] = 1.11$, $p > .05$; Cohen's $d = 0.39$) variables. These findings showed that the researcher failed to reject the null hypothesis and there was no statistically significant difference between the self-confidence scores of general and specialized high school mathematics teachers in terms of their TPCK, TPK, TCK or TK. In fact, all effect sizes were negligible with respect to effect sizes estimated in Timur (2011) or effect sizes estimated from the item-level differences in this study.

Table 17
Test statistics and effect sizes

	TPCK	TPK	TCK	TK
t value	-0.37	0.22	0.48	1.11
Cohen's *d*	0.12	0.08	0.18	0.39

Note. Degrees of freedom = 39.

A post-hoc power analysis estimated that the achieved power as 10% for scores in TPCK, 8% in TPK, 13% in TCK, and 31% in TK measures, indicating that a larger sample size would be needed for statistical significance. Figures 6, 7, 8, and 9 present the visual representations of the confidence intervals (95%) associated with the point estimates of means for the four scales.

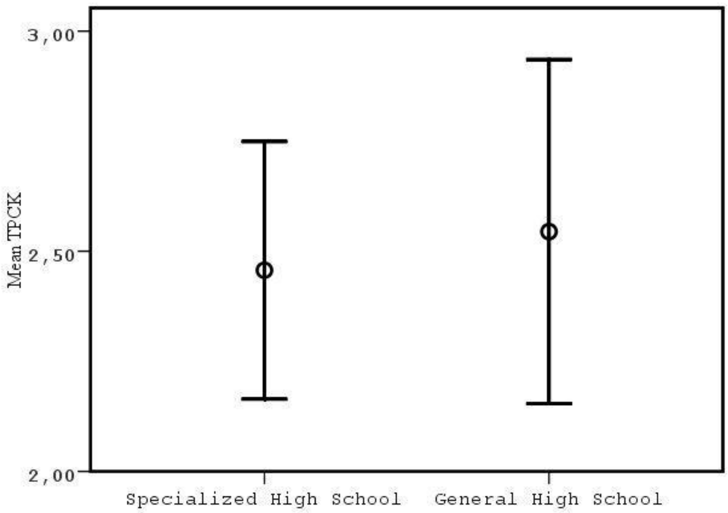

Figure 6. 95% confidence interval for TPCK

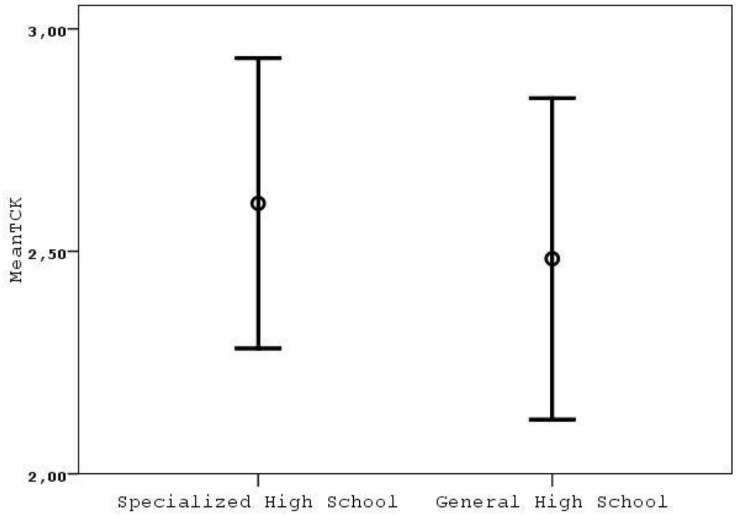

Figure 7. 95% confidence interval for TCK

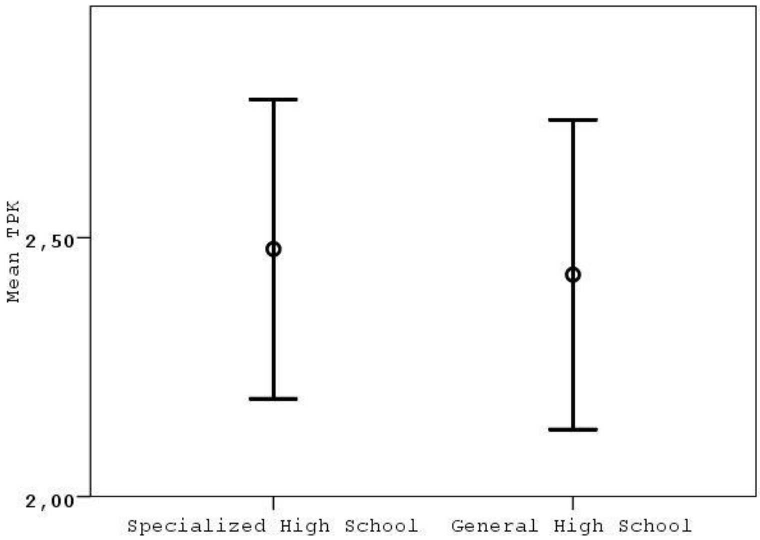

Figure 8. 95% confidence interval for TPK

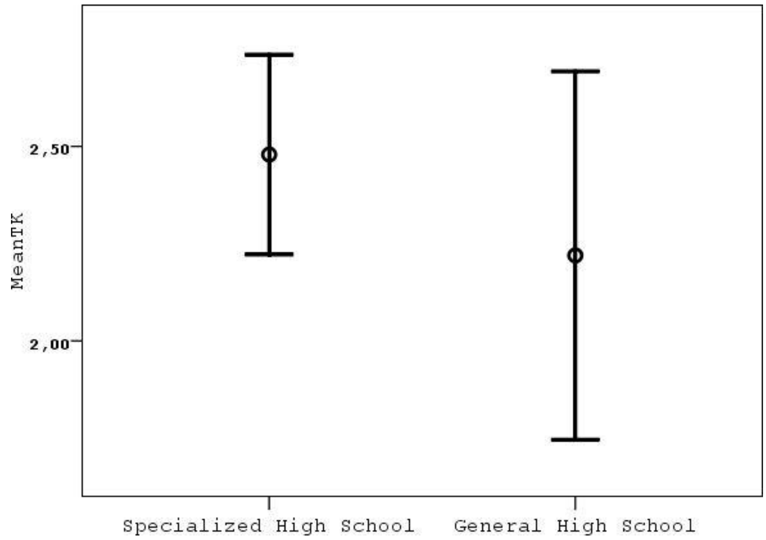

Figure 9. 95% confidence interval for TK.

Means from the four scales for each type of school had a very large overlapping area. This means, in the 95% confidence interval, that there was no evidence to say that population means were different in terms of TPCK, TPK, TCK, and TK.

The instrument yielded data with high reliability estimates in technological pedagogical content knowledge (TPCK), technological pedagogical knowledge (TPK), technological content knowledge (TCK), and technological content knowledge (TK) measures with moderately strong and close correlations between measures. It is evident from the study that mathematics teachers of specialized schools are not any more mentally prepared to implement the Fatih Project technologies than their colleagues working at general schools. It is evident from the strong correlation between the TPCK and TCK scores that teachers are associating their content knowledge with their pedagogical content knowledge (Kleickmann, et al., 2013).

CHAPTER 5: DISCUSSION

Introduction

In this chapter, discussion of the major findings, concluding remarks, implications for practice, and limitations of the current research were included by referring to the previously conducted research. Moreover, some implications for further research were proposed.

Discussion of the major findings

The current study contributed to the Fatih Project and implicitly to the teacher education and selection system in Turkey by investigating the mental readiness of mathematics teachers in integrating technology into their teaching. The instrument yielded data with high reliability estimates in technological pedagogical content knowledge (TPCK), technological pedagogical knowledge (TPK), technological content knowledge (TCK), and technological content knowledge (TK) measures with moderately strong and close correlations between measures, indicating the usefulness of the four-scale model. This is noteworthy in the Turkish context for two reasons: First, there are relatively small number of technology integration measures available for in-service teachers (Öztürk & Horzum, 2011) compared to measures developed for pre-service teachers (e.g., Erdemir, Bakırcı & Eyduran, 2009; Timur, 2011; Timur & Tasar, 2011). Second, the overwhelming majority of the existing instruments, which are grounded in the social cognitive theory (Bandura, 2006), are developed for pre-service teachers (e.g., Bursal, 2010; Cakiroglu, 2008; Cakiroglu, Cakiroglu & Boone, 2005; Corlu, 2012). Hence, the instrument can also be useful as a measure of in-service teachers' mental readiness, particularly when defined in terms of their self-confidence levels. Overall, the instrument yielded data that indicates it is valuable to investigate self confidence levels of mathematics teachers in general and specialized high schools within the technology domain (Asan, 2003; Erdemir, Bakırcı & Eyduran, 2009; Landry, 2010; Timur, 2011). The researcher of the current study encourages scholars to examine how the instrument performs with other samples and demographic groups. A confirmatory factor analysis with larger sample sizes is recommended as a future research topic.

It is evident from the study that mathematics teachers of specialized schools are not any more mentally prepared to implement the Fatih Project technologies than their colleagues working at general schools. The scope of the Specialized Schools Teacher Selection Examination (SSTSE), which tests content knowledge of teachers for employment at specialized schools, can be speculated as the reason to explain this finding (Staiger & Rockoff, 2010). Educating the future innovators of the country requires teachers with skills more than mere content knowledge (National Research Council, 2011; Organisation for Economic Co-operation and Development [OECD], 2010; Shulman, 1986). Hence, the current form of the selection examination may not be successful in selecting the most technologically or innovatively literate (Erdogan, Corlu & Capraro, 2013) and self-confident teachers in the country. Authors suggest MoNE to reconsider the scope of this examination by testing potential candidates' TPCK levels, as well.

In consideration of the high overall efficacy levels of Turkish teachers (OECD, 2009) or particularly of Turkish mathematics teachers (Corlu, Erdogan & Sahin, 2011), participants' not so strong confidence in integrating technology into their teaching is critically important. In particular, the low mean scores from the TK measure obtained from this study may indicate a poor technology knowledge of Turkish mathematics teachers, regardless of their pedagogy or pedagogical content knowledge (Sadi et al., 2008). Alternatively, this finding can be explained with the negative effects of the initial teacher employment system on pre- and in-service teachers' self-efficacy beliefs. Research explains that the teacher education programs lose their credibility because of the extreme importance given to this test at the teacher education level (Özoğlu, 2010). Another explanation may come from the lack of professional development opportunities that foster integrated teaching knowledge (Corlu, 2012), pedagogical content knowledge or technological pedagogical content knowledge (Ball, Thames & Phelps, 2008; Kline, 2005; Schleigh, Bossé & Lee, 2011; Shulman, 1987). The poor professional development opportunities or too much emphasis on pedagogy or content alone, can be harming in-service mathematics teachers' self-confidence in integrating new technologies into their teaching (Öztürk, 2005). In addition, the budgetary constraints of both faculties of education and schools (Çiftçi, Taşkaya & Alemdar, 2013; Gürol, Donmuş & Arslan, 2012) may prevent teacher candidates and teachers in developing a confidence by practising teaching with these technological tools. The research, which shows the need for qualified teachers in Turkey is twice the OECD average (Büyüköztürk, Akbaba-Altun & Yildirim, 2010), supports all these explanations.

It is evident from the strong correlation between the TPCK and TCK scores that teachers are associating their content knowledge with their pedagogical content knowledge (Kleickmann, et al., 2013). This finding is important to show that previous research findings, which found considerably high correlation between these two constructs, were valid in the technology domain, as well (Phelps & Schilling, 2004).

Concluding remarks

This study investigated the self confidence levels of general and specialized high school mathematics teachers in the technology domain. The researcher found that there was not a statistically significant difference between the self confidence levels of mathematics teachers in general and specialized high schools.

Technology has been presented as an important component of instruction and MoNE recommended teachers to use technology while teaching their subject areas (MoNE, 2012b). Together with the Fatih Project, technology integration has become an essential element of being a qualified teacher. Specialized high school teachers can be considered highly qualified teachers because they are selected to educate the top 5% of the student population in Turkey (Alacaci & Erbaş, 2010). Therefore, I believe that specialized high school teachers should be hired and evaluated according to their technology integration knowledge in addition to their knowledge in pedagogy, content, and pedagogical content.

Technology integration is not only important for specialized school teachers but also for all teachers in Turkey. The changes in PPSE test, the addition of content and pedagogical content knowledge questions, have been positively evaluated by many researchers (Başkan & Alev, 2009; Ayas, Aydın & Corlu, 2013). I believe that all teachers should be hired and evaluated according to their technology integration knowledge in addition to their knowledge in pedagogy, content, and pedagogical content. Moreover, pre-service teacher education system should foster technological pedagogical content knowledge.

Given that Turkish teachers are generally young professionals (Corlu, Erdogan & Sahin, 2011), it was surprising to find that the age distribution in my sample was in the 40-49 interval. Because of the intense interest shown towards technology by Turkish youth, it may be expected that young teachers may be more confident about integrating technology into their teaching (Dursun, Kuzu, Kurt, Güllüpınar & Gültekin, 2013; Özçelik & Kurt, 2007). I believe that young teachers, who may be more keen on technology integration, should be encouraged to be teachers at specialized high schools.

Implications for practice

Because in today's classrooms, technology has become an integral part of instruction, all teachers need to be competent in integrating technology into their teaching (MoNE, 2012d). Therefore, technology integration knowledge and skills have become one of the requirements of being a qualified teacher. I suggest that the teacher selection process for both general and specialized high schools should be enhanced by adding some TPCK questions. If MoNE truly believes that a qualified teacher should successfully integrate technology into teaching, then teachers should be selected accordingly.

The results of the current study showed that mathematics teachers do not feel strongly confident to integrate technology into their teaching because they do not know how to construct e-contents. I suggest the implementers of the Fatih Project and the expert technologists to develop relevant and worthwhile e-contents for each subject area (Dursun, Kuzu, Kurt, Güllüpınar, & Gültekin, 2013). Therefore, teachers may combine these materials with their PCK and provide a better learning and teaching environment.

Implications for further research

This study investigated the confidence levels of general and specialized high school mathematics teachers with a survey method. However, surveying is not the only way of determining teachers' confidence levels in the technology domain. Field observations can be conducted to gain insights on teachers' confidence levels in the classroom. Alternatively, interviews can be conducted with teachers to learn more about their self evaluation of their confidence levels. The scope of this research was limited to self evaluation of teachers' confidence levels. Future researchers can triangulate their results by asking students' or administrators' opinions regarding teachers' confidence levels. It may be also of interest to researchers to investigate confidence levels of teachers from other subject areas. Because there is a need to examine how the instrument performs for other subject area teachers and in other districts of Ankara or in other cities across Turkey, a replication study is strongly recommended.

Limitations

The findings of the study are limited to the public high schools in Turkey and the teachers in Ankara who were asked to voluntarily complete the TPCK survey. Also, low achieved power (small sample size), despite the pilot study, is a limitation.

However, this also shows that pre-service teachers, who participated the pilot study, and in-service teachers, who participated in the actual study, may not be similar in terms of their self confidence in integrating technology into their lessons. The low response rates may also limit obtaining more accurate results. The data collection happened at a specific time so the results cannot be as strong as the one conducted over a period of time.

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APPENDICES

APPENDIX 1: Data collection instrument

TEKNOLOJI iLE BÜTÜNLEŞİK MATEMATİK ÖĞRETİMİ İÇİN ÖZ GÜVEN ÖLÇEĞİ

Cinsiyetiniz

- ❍ Kadın
- ❍ Erkek

Yaşınız

a. 25'in altı b. 25-29 c. 30-39 d. 40-49 e. 50-59 f. 60 ve üzeri

Şu an çalıştığınız okul hangi kategoriye en uygundur?

- ❍ Devlet Anadolu Lisesi
- ❍ Devlet Fen Lisesi
- ❍ Devlet Genel Lisesi
- ❍ Diğer (Belirtiniz.) ____________________

Mezun olduğunuz en son eğitim seviyesi nedir?

- ❍ Yüksek Okul (2 yıllık önlisans ya da eşdeğerlisi)
- ❍ Üniversite (4 yıllık lisans)
- ❍ Master (Lisans üstü)
- ❍ Doktora (Lisans üstü)

Üniversitelerin hangi fakültelerinden mezunsunuz?

- ❍ Eğitim Fakültesi
- ❍ Fen/ Fen Edebiyat Fakültesi
- ❍ Diğer (Belirtiniz.) ____________________

Kaç yıldır öğretmenlik yapıyorsunuz?

Şu anki kurumunuzdaki hizmet süreniz (yıl olarak)---------------------------

Toplam hizmet süreniz (yıl olarak) --------------------------

“Dijital Teknoloji" kavramından ne anlıyorsunuz? Örneklendirebilir misiniz?

Fatih Projesi hakkında bilginiz var mı? Sınıflarınıza hangi yenilikleri getireceğini biliyor musunuz? Kısaca açıklar mısınız?

Aşağıda belirtilen durumlarda kendinize ne ölçüde güvendiğinizi belirtiniz.

Dijital teknoloji kavramı ile grafik çizen hesap makineleri, akıllı tahtalar, tablet bilgisayarlar ve benzeri araçlar ile bu araçlarda kullanılan uygulamalar kastedilmektedir: örneğin, Mathematica, Mapple, Geometer's Sketchpad, Geogebra, sanal manipülatifler, ve matematik ile alakalı tablet uygulamaları. Tablet uygulamaları ifadesinden tablet bilgisayarlarda kullanılan aplikasyonlar ya da küçük programlar düşünülebilir.

	Hiç güvenmi-yorum	Güvenmi-yorum	Karar-sızım	Güveni-yorum	Çok güveniyo-rum
TPCK1.Matematik ile ilgili kavramları öğretmenize yardımcı olacak tablet bilgisayar uygulamalarını (aplikasyonlar) İnternetten bulmak ve kullanmak.	❍	❍	❍	❍	❍
TPCK2. Dijital teknolojileri öğrencilerin m atematikteki yaygın kavram yanılgılarına çözüm üretmek için kullanmak	❍	❍	❍	❍	❍
TPCK3. Dijital teknolojileri öğrencilerin matematiksel araştırma-sorgulama yapmaları için kullanmak	❍	❍	❍	❍	❍
TPCK4.Dijital teknolojileri matematik etkinlikleri yapmak için kullanmak	❍	❍	❍	❍	❍

	Hiç güvenmiyo-rum	Güvenmiyo-rum	Kararsı-zım	Güveniyo-rum	Çok güveniyo-rum
TPCK5.Dijital teknolojileri, öğrencilerin matematik konularını araştırmak için kullanmalarına yardımcı olmak	❍	❍	❍	❍	❍
TPCK6.Matematiksel verileri düzenlemek ve verilerdeki desenleri (anlamları) ortaya çıkarmak için öğrencilerin dijital teknolojileri kullanmalarına yardımcı olmak.	❍	❍	❍	❍	❍
TPCK7.Olayları matematiksel olarak gözlemleme kabiliyetlerini geliştirmek için öğrencilerin dijital teknolojileri kullanmalarına yardımcı olmak	❍	❍	❍	❍	❍
TPCK8.Öğrencilerin verilen bir model karşısında elde edilebilecek verileri bulmalarını sağlayan dijital teknolojileri kullanmalarına olanak sağlamak.	❍	❍	❍	❍	❍
TPK1. Öğretim verimliliğimi arttırmak için dijital teknolojileri kullanmak	❍	❍	❍	❍	❍
TPK2. Öğrencilerle iletişimi geliştirmek için dijital teknolojileri kullanmak	❍	❍	❍	❍	❍
TPK3. Teknolojiyle zenginleştirilmiş bir sınıfı etkili olarak yönetmek için dijital teknolojileri kullanmak	❍	❍	❍	❍	❍

	Hiç güvenmiyo-rum	Güvenmiyo-rum	Kararsı-zım	Güveniyo-rum	Çok güveniyo-rum
TPK4. Öğrencileri motive etmek için dijital teknolojileri kullanmak	❍	❍	❍	❍	❍
TPK5. Öğrencilere daha iyi bilgi sunumu yapmak için dijital teknolojileri kullanmak	❍	❍	❍	❍	❍
TPK6. Öğrencileri öğrenmeye aktif olarak katmak için dijital teknolojileri kullanmak	❍	❍	❍	❍	❍
TPK7.Öğrenci değerlendirmesinde yardımcı olacak dijital teknolojileri kullanmak	❍	❍	❍	❍	❍
TCK1.Matematik öğretmenlerine, normal şartlarda gözlenmesi zor doğa olaylarını gözleme imkânı veren dijital teknolojileri kullanmak.	❍	❍	❍	❍	❍
TCK2.Matematik öğretmenlerine, doğal olayların temsilini(gösterimini) hızlandırma veya yavaşlatma imkânı sağlayan dijital teknolojileri kullanmak.	❍	❍	❍	❍	❍
TCK3.Matematik öğretmenlerine, bilimsel olayların modellerini oluşturma ve modeller üzerinde işlem yapma imkânı sağlayan dijital teknolojileri kullanmak.	❍	❍	❍	❍	❍
TCK4.Matematik öğretmenlerine, başka türlü toplanması zor olan verileri kayıt etmeye imkân sağlayan dijital teknolojileri kullanmak.	❍	❍	❍	❍	❍

	Hiç güvenmiyo-rum	Güvenmiyo-rum	Kararsı-zım	Güveniyo-rum	Çok güveniyo-rum
TCK5.Matematik öğretmenlerine, matematiksel verileri düzenleme ve verilerdeki başka türlü görülmesi zor desenleri görme imkânı sağlayan dijital teknolojileri kullanmak.	❍	❍	❍	❍	❍
TK1.Bir internet sitesinden tabletinize resim veya aplikasyonlar kaydetmek.	❍	❍	❍	❍	❍
TK2.İhtiyaç duyduğunuz bir konu hakkında güncel bilgiler bulmak için dijital teknolojileri kullanmak	❍	❍	❍	❍	❍
TK3.Dosya eklentisi olan bir e-posta göndermek.	❍	❍	❍	❍	❍
TK4.Dijital teknolojileri kullanarak derste sunmak üzere bir sunum hazırlamak	❍	❍	❍	❍	❍
TK5.Tablette içinde metin ve grafik olan bir belge oluşturmak.	❍	❍	❍	❍	❍
TK6.Yeni bir dijital teknolojiyi kendi kendinize öğrenmek	❍	❍	❍	❍	❍
TK7.Kullanacağınız yeni bir programı bilgisayarınıza kurmak.	❍	❍	❍	❍	❍
TK8.Dijital bir fotoğraf çekmek ve düzenlemek	❍	❍	❍	❍	❍
TK9.Bir video klip oluşturmak ve düzenlemek	❍	❍	❍	❍	❍
TK10.Kendi İnternet sitenizi oluşturmak.	❍	❍	❍	❍	❍
TK11.Web 2.0	❍	❍	❍	❍	❍

APPENDIX 2: Written permission for the use of instrument

Folders
Last Refresh:
Mon, 11:52 pm
(Check mail)

INBOX (1)
Drafts
Sents
Spam
Trash (Purge)

Folder Sizes

Subject: Re:
From: Betül Timur <betultmr@gmail.com>
Date: Sun, July 29, 2012 11:32 pm
To: ZEHRA ÇATMA <zehra.catma@bilkent.edu.tr>
Priority: Normal
Allow Sender: Allow Sender | Allow Domain | Block Sender | Block Domain
Create Filter: Automatically | From | To | Subject
Options: View Full Header | View Printable Version | Download this as a fi

Merhaba,
tezimi YÖK'ten indirebilirsiniz. Anketi de kullanabilirsiniz.
herhangi bir sorunuz olursa yardım edebilirim.

2012/7/29 "ZEHRA ÇATMA" <zehra.catma@bilkent.edu.tr>

> Dear Dr. Timur
>
> I am currently pursuing a Master of Arts degree at the Graduate School of
> Education at Bilkent University. One of the requirements of successfully
> completing this program is to write a research-based thesis and defend it
> in front of a committee of scholars. I am at the proposal stage and would
> like to investigate the self-confidence levels of Turkish mathematics
> teachers in utilizing their Technological Pedagogical Content Knowledge
> (TPCK) for the Fatih Project. Fatih Project is a multi-million
> government-sponsored project with the ultimate goal of digitalizing all
> teaching and learning in Turkish classrooms through tablets in the next
> 3-5 years. The theoretical population of my study includes mathematics
> teachers in Ankara who are eligible to participate in the Fatih Project.
>
> Having read your research "Survey of Pre-service Teachers' Knowledge of
> Teaching and Technology", I found parts of your instrument to be a good
> match for use in my research. I am therefore writing to kindly ask for

APPENDIX 3: Ethics board permission

018444

T.C.
ANKARA VALİLİĞİ
Milli Eğitim Müdürlüğü

Sayı : B.08.4.MEM.0.06.20.01-60599/ 77785 03/10/2012
Konu : Araştırma İzni
Zehra ÇATMA

BİLKENT ÜNİVERSİTESİNE
(Eğitim Bilimleri Enstitüsü)

İlgi: a) MEB Yenilik ve Eğitim Teknolojileri Genel Müdürlüğünün 2012/13 nolu genelgesi.
b) Üniversitenizin 20/09/2012 tarih ve 17025 sayılı yazısı.

Üniversiteniz Eğitim Bilimleri Enstitüsü yüksek lisans öğrencisi Zehra ÇATMA' nın "**Matematik öğretmenlerinin teknoloji ile bütünleştirilmiş matematik öğretimi öz güven seviyelerinin araştırılması: Ankara'daki matematik öğretmenleri Fatih Projesine hazır mı?**" konulu tezi ile ilgili çalışma yapma isteği Müdürlüğümüzce uygun görülmüş ve araştırmanın yapılacağı İlçe Milli Eğitim Müdürlüğüne bilgi verilmiştir.

Mühürlü anketler (5 sayfadan oluşan) ekte gönderilmiş olup, uygulama yapılacak sayıda çoğaltılması ve çalışmanın bitiminde iki örneğinin (CD/disket) Müdürlüğümüz Strateji Geliştirme Bölümüne gönderilmesini rica ederim.

İlhan KOÇ
Müdür a.
Şube Müdürü