Instructors' Perceived Knowledge of Technological Pedagogical Content Knowledge (TPACK) at the Faculty of Education

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ABSTRACT

The use of technology in instruction has brought about different perceptions. The need to know how teachers integrate technology in instruction has brought along side different views. Therefore, this study mainly seeks to understand these views on instructors' perceived knowledge of technological pedagogical content knowledge (TPACK) as it examines how their views changes according to gender, age, period of service, ranking, employment status, department, and the state of in-service training oriented towards the use of technology. In order to achieve the above aim, the researcher statistically examined Eastern Mediterranean University (EMU) Faculty of Education instructors' perceived knowledge of TPACK. In this thesis, a TPACK survey instrument was administered to 53 instructors, a questionnaire was used to ascertain their perception levels across the seven TPACK dimensions. Mean, standard deviation, percentage, frequency and non-parametric tests (Mann Whitney U and Kruskal-Wallis test) were used for data analysis. The study reveals that instructors' perceptions about TPACK were significantly high across all knowledge dimensions and there were statistical significant differences on how instructors viewed TPACK according to the above listed variables. These differences took place in Technological Knowledge (TK) and Pedagogical Content Knowledge (PCK) according to gender, Technological Knowledge (TK) according to age, Technological Knowledge (TK) according to period of service, Technological Knowledge (TK), and Technological Pedagogical Knowledge (PCK) according to employment status, Technological Knowledge (TK), Technological Pedagogical Knowledge (TPK) , and Technological Pedagogical Content Knowledge (TPACK) according to department and Pedagogical

Content Knowledge (PCK) according to in-service training. There was no change according to ranking.

Keywords: TPACK, Technological Pedagogical Content Knowledge, Perceived Knowledge of TPACK

ÖZ

Öğretimde teknolojinin kullanımı farklı algıların oluşmasına yol açmıştır. Öğretmenlerin öğretimde teknolojiyi nasıl bütünleştirdiklerini bilme gereksinimi farklı görüşleri beraberinde getirmiştir. Bu araştırmada öğretim görevlilerinin teknolojiye ilişkin pedagojik içerik bilgileri (TPACK) incelenmektedir. Araştırma öğretim görevlilerinin görüşlerinin cinsiyet, yaş, hizmet süresi, kıdem, sınıf, bölüm ve teknolojinin kullanımına yönelik hizmet içi eğitim açısından değişip değişmediği araştırılmıştır. TPACK veri toplama aracı Doğu Akdeniz Üniversitesi Eğitim Fakültesindeki 53 öğretim görevlisine uygulanmıştır. Ayrıca, öğretim görevlilerinin yedi bilgi alanındaki düzeylerini belirlemek amacıyla bir veri toplama aracı kullanılmıştır. Verilerin analizinde ortalama, standart sapma, yüzdelik, sıklık hesaplanmış ve parametrik olmayan testler (Mann Whitney U ve Kruskal-Wallis testi) kullanılmıştır. Çalışmada, öğretim elemanlarının TPACK algılarının tüm bilgi boyutları açısından anlamlı derecede yüksek olduğu ve yukarıda (daha önce) listelenen değişkenlere göre de, öğretim elemanlarının TPACK algılarında istatistiksel olarak anlamlı farklılıklar olduğu ortaya çıkmıştır. Bu farklılıklar, cinsiyete göre Teknolojik Bilgi (TK) ve Pedagojik İçerik Bilgisi (PCK), yaşa göre Teknolojik Bilgi (TK), hizmet süresine göre Teknolojik Bilgi (TK), istihdam durumuna göre Teknolojik Bilgi (TK), ve Teknolojik Pedagojik Bilgi (PCK), bölüm ve hizmet içi eğitime göre Pedagojik İçerik Bilgisi (PCK) Teknolojik Bilgi (TK), Teknolojik Pedagojik Bilgi (TPK) ve Teknolojik Pedagojik İçerik Bilgisi (TPACK) yer almıştır. Sıralamaya göre değişiklik olmadığı belirlenmiştir.

Anahtar Kelimeler: TPACK, Teknolojik Pedagojik İçerik Bilgisi, TPACK’ın Algı Bilgisi

DEDICATION

To God almighty, family and friends. To my loving and supportive parents, Mr. and Mrs. Chukwuemeka, your words full of wisdom has been a source of inspiration along this path. To my siblings, Zion, my lovely sister for always cheering and reminding me that I am a STAR, leading the three wise men. Odira and Stephen, my brothers who has held my hands up high. To my uncle, Barrister John Obiora Okafor, for your support, I am most grateful.

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INTRODUCTION

The acceptance of technology into education has given rise to the concept of educational technology. Educational technology is concerned with the study of ways and methods of facilitating electronic learning (e-learning), improving learning and educational performance using technological procedures and resources. It is concerned with the design, development, utilization, management, and evaluation of processes and resources for learning (Luppicini, 2005). This area of study has been receiving great attention from various stakeholders in education all over the world due to the current strive between technology advanced and technology advancing nations to have ICT in the schools' learning and teaching technique (Agyei and Voogt, 2012; Chai, Koh, and Tsai, 2013; Shin et al., 2009).

The word technology is a broad term, although it is being used in the sphere of education because the specific tools used changes constantly. These tools often used are either digital or computer-based which allows source materials to cross boundaries of time and space, provides students with simulations and games that enables them to test and explore high-consequential scenarios at low or no risk, provides immediate feedback for students to practice the skills they need, provides creativity tools which enables the students to transform their learned concepts into various forms, creates opportunities for social networks that allows students to increase collaboration and teamwork in a learning environment, provides publishing resources that allows students to contribute content, provides simulations and games that allows students to test hypotheses and explore high-consequence scenarios at low-risk. Although technology has been introduced into the educational system, full and effective integration is still lacking. This is because technology alone cannot lead to change (Koehler and Mishra, 2005). The change can only come from the way the instructors make use of the technology in educational processes. For example, having smart board in a classroom will make less or no difference in the students' learning process except the teacher develops ways of making the students to actively participate i.e. methods of engagement. Of what use, is the smart board to the learning process if only what the teacher does is to write on it, as is the case of the chalk board? The teacher is expected to have a certain level of technological knowledge or rather develop technological knowledge (TK) which will aid his or her choice of pedagogy – pedagogical knowledge (PK), towards structuring a specific subject matter – content knowledge (CK). The relationship of these processes is what gave rise to different interceptions of knowledge such as TPK (Technological Pedagogical Knowledge), TCK (Technological Content Knowledge), PCK (Pedagogical Content Knowledge) to form a whole knowledge framework – TPCK, now known as TPACK (Technological Pedagogical Content Knowledge) (Jang and Tsai, 2012; Jang and Tsai, 2013; Koh and Chai, 2014; Koehler and Mishra, 2009; Mishra and Koehler, 2006; Schmidt, Baran, Thompson, Mishra, Koehler, and Shin, 2009). This is a fundamental notion of constructivism, which views effective learning as to being student-centered and having the ability to actively engage participants (Sessoms, 2008).

Amidst this technological development lies a “danger that teachers will not use the tools as they are intended” (Sessoms, 2008, p. 86), because instead of fully making use of technological tools, they rather use it to support traditional oriented paradigm. Sessoms (2008) stated that “the problem is that teachers are not trained to think about teaching and learning as an interactive process that encourages the use of technology (p. 87)”. Therefore, an accurate framework that allows measurement of teachers' knowledge to aid in aligning the teachers thinking towards the adequate usage of ICT in the educational process is desirable. The advancement in ICT demands for teachers' knowledge and enthusiasm to incorporate technology in their instruction process. This is where technological pedagogical content knowledge (TPACK) (Mishra and Kohler, 2006) comes into consideration, since teachers' knowledge has to be described and measured in order to aid proper integration and improvement. TPACK is a theoretical framework (Koh, Chai and Tsai, 2013) that defines and creates a systematic view of teachers' expertise i.e. the knowledge teachers need in order to effectively integrate information and communication technology in teaching, in order to improve students' learning. Chai et al., (2013) defined TPACK as a synthesized form of knowledge for the purpose of integrating ICT/educational technology into classroom teaching and learning. Jang and Tsai (2013) viewed TPACK as a consolidated system that promotes students learning because of its instrumentality that combines different interacting components designed to work as a coherent entity. What does this coherence do? Koehler and Mishra (2005) emphasized on how technology, pedagogy, and content interact with one another and the understanding, as an approach towards technology integration. These cohered entities make up what is called the TPACK framework.

1.1 Problem Statement

The use of technologies has grown, leaving an obvious influence on the educational field. One of such fields is the Faculty of Education. The Faculty of Education instructors have benefitted from these technological advancements in many ways. For example, they use the internet for research purposes, computers are used for both personal and professional purposes, spread sheets and other sophisticated software are used by instructors for assessments and scheduling of class activities, webpages and blogs are developed for learning activities, grading class activities and result checking has been easier and quicker, interactive white boards used to enhance classroom interactivity and so forth (Elçi, 2012). Consequently, the effect is a great rise in the demand for technology integration as well as the creation of a popular field for researchers to explore. Majorly on the part of the pre-service teachers, technological pedagogical content knowledge development is believed to aid in the creation of an adequate technology integration knowledge for a better teaching experience as they move on into the teaching profession and from the student perspective, it aids in creating a better learning experience (Koh et al., 2013; Mishra and Koehler, 2006).

Lately, researchers have been directing their focus to the in-service teachers since they also need technology development for effective pedagogy (Agyei and Voogt, 2012, Chai et al., 2013; Koh et al., 2013; Mudzimiri, 2012). Some of the issues of concern were the inability of teachers to use these technological tools as intended, teachers are not trained to think about teaching and learning as an interactive process that encourages the use of technology (Sessoms, 2008).

There were complex problems experienced by the advent of technology in education. These complex problems are caused by the complexities of technology, rigorous requirements, relative solutions, finding the right combination of technologies to work with existing teaching approaches and instructional objectives etc. In addition, a need for critical consideration of technology knowledge required and how this knowledge is been developed in teaching process (Mishra and Koehler, 2008). The TPACK framework developed by Mishra and Koehler has been considered suitable for thinking about these complex problems posed by technology integration and has been in use by many other researches (Chai et al., 2010; Graham, 2011; Jang and Tsai, 2012; 2013; Koh and Chai, 2014; Lin et al., 2013; Koehler and Mishra, 2005; Koehler and Mishra, 2009; Koh et al., 2013; Mishra and Koehler, 2006; Mishra and Koehler, 2008; Niess, 2005; Niess, 2006; Niess et al., 2009; Schmidt et. al., 2009; Shin et al., 2009).

Elçi (2012) research on professional development in teaching and learning at EMU North Cyprus identified various needs of faculty members of which Faculty of Education was among the research sample. One of these needs mentioned is the issue of technological development, which this study tends to proffer solution to, through the lens of TPACK framework. Elçi (2012) highlighted that "faculty seems not to connect technology to pedagogy adequately" (p. 134), which may be because of the lack of technological pedagogical content knowledge. This study can also help raise instructors' awareness of TPACK (Koh et al., 2013; Mishra and Koehler, 2006).

Throughout the years of progress in TPACK research area, there has not been any study conducted in this regards in North Cyprus (NC). These issues raised about technology are issues that exist in institutions where there are technological changes such as interactive white board usage, distance learning tools, sophisticated software, computers etc. (Koh et al., 2013; Mishra and Koehler, 2006; Shin et al., 2009) of which Eastern Mediterranean University (EMU) Faculty of Education is a perfect match of such, therefore the instructors will in some aspects be experiencing such problems. It was decided that this study should be conducted in the above-mentioned institution since they are one of the strong pioneers of learning.

This study was carried out at the Faculty of Education in Eastern Mediterranean University (EMU). The study aimed at investigating instructors' perceived knowledge of TPACK via their experiences in the usage of technology in teaching within their various contexts, thereby giving an in-depth understanding of their current perceptions on the integration of technology in their teaching, the instructors' technological pedagogical content knowledge – TPACK and how the TPACK framework has helped them in thinking about the above-mentioned complexities of technology integration.

This study further discloses the relationship between the instructors' opinions of TPACK and their demographic characteristics such as age, gender, period of service, ranking, employment status, department, and the state of in-service training oriented towards the use of technologies.

1.2 Purpose

The aim of this study is to investigate instructors' views concerning Technological Pedagogical Content Knowledge (TPACK) in the context of their experience at the Faculty of Education.

1.3 Research Question

This study intends to achieve the above purpose through the following research questions:

1. What are the instructors' perceptions with regard to technological pedagogical content knowledge?
2. How do the perceptions of instructors in technological pedagogical content knowledge change according to gender, age, period of service, ranking, employment status, department, and the state of in-service training oriented towards the use of technologies?

1.4 Importance

This study would awake the need for technology thinking as a process in the development of an effective learning environment at the Faculty of Education using TPACK framework. This may lead to more concern been given to instructional material design whereby instructors at the Faculty of Education will become effective and efficient in technology integration and use technology knowledge, pedagogical knowledge, and content knowledge in consideration with other components arising from the knowledge interceptions such as technological pedagogical knowledge, technological content knowledge, pedagogical content knowledge and technological pedagogical content knowledge.

From the reports of the instructors' perceived knowledge of TPACK, policy makers will be able to understand how much gap of technology integration, has been bridged between the period of Elçi (2012) research and now. This study identifies beliefs about technology integration in teaching and learning in Faculty of Education as suggested by Elçi, (2012), through the investigation of the instructors' perceived knowledge of TPACK. This study may also be able to create necessary discussions and policies, which will lead to instructors' TPACK improvement and growth directed towards meeting the international society for technology in education (ISTE) standards as highlighted in the next chapter.

In addition, this study would aid in raising the awareness of instructors at the Faculty of Education to the development of thoughtful pedagogical uses of technology. According to the argument of Mishra and Koehler (2008) *"that thoughtful pedagogical uses of technology require the development of a complex, situated form of knowledge that we call Technological Pedagogical Content Knowledge (TPCK)"* (p. 1017). This has been the global need for instructors in this century.

1.5 Limitation

The amount of data collected were limited only to instructors in the Faculty of Education at EMU 2013-2014 spring semester. Also the data for this research was collected by self-report of perceived knowledge of TPACK, hence may not be really what they perceive, and might not be used to ascertain their competency.

1.6 Definition of Key Terms

Perceived Knowledge: This is the kind of knowledge acquired by perception (intuitive recognition) (Koh and Chai, 2014).

Instructors' TPACK: This is the knowledge instructors need to effectively integrate technology into their teaching practices (Koh et al., 2013; Mishra & Koehler, 2006).

TK: This means technological knowledge. This is the knowledge of technology tools such as computers, the internet, digital video etc. (Koh et al., 2013; Mishra and Koehler, 2006).

CK: This means content knowledge. It is the knowledge about a particular subject matter that is to be learned or taught (Koh et al., 2013; Mishra and Koehler, 2006).

PK: This means pedagogical knowledge. It is the in-depth knowledge of teaching methods, practices, strategies and procedures (Koh et al., 2013; Mishra and Koehler, 2006).

PCK: This means pedagogical content knowledge. It is the knowledge of methods and processes of teaching a subject matter (Koh et al., 2013; Mishra and Koehler, 2006).

TCK: This means technological content knowledge. This is the knowledge of how to use technology to represent a subject matter (Koh et al., 2013; Mishra and Koehler, 2006).

TPK: This means technological pedagogical knowledge. It is the knowledge of how to use technology to implement or adopt different methods (Koh et al., 2013; Mishra and Koehler, 2006).

TPACK: This means technological pedagogical content knowledge. It is the knowledge, which arises from the blending of technology, pedagogy, and content (Koh et al., 2013; Mishra and Koehler, 2006).

Chapter 2

LITERATURE REVIEW

2.1 The Use of Technology in Education

Over the years, there has been an increasing growth in technology, taking place in schools and other citadels of learning. Teachers are faced with the pressure of integrating technology in meaningful ways. In this study, technology will refer to all educational aided electronic devices and others that provide interactivity. In major countries like United States, United Kingdom and other parts of Europe, one can hardly find classrooms without computers (Agyei and Voogt, 2012, Chai et al., 2013; Mudzimiri, 2012). Majority of schools have changed from the popular black/white board to smart boards, indeed technology has become a common place in the classroom (Weimer, 2001). Consequently, the perceptions of educators have changed rapidly from the conventional traditional classroom mentality. Amidst these improvements, some of the teachers are intimidated by the advent of technology. Some maintain an unwelcoming attitude towards the adaptation of technology and therefore, may consider it irrelevant for their use in teaching because of the various challenges such as protean, unstable, and opaque nature of technology as mentioned by Koehler and Mishra (2009) and probably due to the cost of change. Nowadays, whether or not to use technology in teaching are not more pressing issues to be considered for discussion compared to recent discussions. For example, how to accommodate new emerging technologies, choice of a particular technology for instruction, effective technology adoption, learning styles to aid technology (Agyei and Voogt, 2012), underlining impact of technology on pedagogy (Abik and Ajhoun, 2012) and how to develop technological pedagogical content knowledge in teacher education (Agyei and Voogt, 2012) and technological pedagogical content knowledge TPACK are currently the burgeoning area of research with more application in various regions (Chai et al., 2013).

The main reason for non-use of Technology is insufficient access to hardware and lack of technical support. Very few teachers dislike / fear information and communication technology once they have seen the possibilities but over the years these possibilities which has caused fears have been explored and researchers have highlighted different ingredients necessary for the successful integration of technology in teaching and learning in educational contexts (Agyei and Voogt, 2012, Chai et al., 2013; Koh et al., 2013; Mudzimiri, 2012).

These contexts includes ready access for all learners, presence of a full-time technician devoted to servicing and maintaining for proper functioning (e.g. Laboratories and internet or internet networks), engaging the services of a full-time webmaster for web maintenance, sufficient training for pre-service teachers and in-service teachers, a total commitment by senior management to the implementation of ICT in different subject matters, support and proactive leadership, student-centered approaches in teaching and many other, which have been implemented in this 21st century (Elçi, 2012, Koh et al., 2013).

2.1.1 Varied Use of Technology in Teaching and Learning

According to Abik and Ajhoun (2012), technology evolution has presented various learning forms such as electronic learning – using Electronic, multimedia technologies and the internet to advance the quality of learning and created a better learning experience by facilitating access to resources through remote collaboration, Mobile-learning – using mobile technologies to improve learning. This kind of learning occurs when a student is not static in a place, Pervasive -learning – this learning environment creates complete computer transparency whereby the system adapts to the learners.

Mudzimiri (2012) highlighted that technology is used in education in many ways and can be categorized into two dimensions– productivity and cognitive use. Technologies are used in the productivity category when medium like spreadsheets, e-book, word processors, databases, presentation software and other forms of multimedia are used to enhance learning. On the other hand, technology can be used in the cognitive category when it is used as a medium to accomplish tasks that transcends the mind. For instance, multimedia interaction (simulations that represent real live scenarios) can be incorporated in lessons to enable instructors explain concepts that are too ambiguous or happens too fast and cannot be demonstrated in physical classroom. Virtual manipulatives are used to explain fractions, explore a number of patterns and then make conjectures which otherwise would be challenging to do mentally. In every branch of education, there are hardware (these are electrical and electronic components that make the computer) and software such as web-browsers, email programs, and word-processors (Mishra and Koehler, 2008) which the instructors can fall back on in order to aid and create effective learning environment. Software is a preprogramed set of instructions that perform a specific task overtime.

Technology advancement in education has also changed learning approaches. Effective learning has transited from teacher-centered into student-centered environments where students have to be actively involved in the learning process while the teacher must be informed in order to be able to create such constructive environments. The teacher that must function in the world of the 21st century students must be that digital teacher – a digital teacher is one whose instruction includes presentations that are media rich and interactive. Teachers are looking for more ways to engage students in the lesson, and the only way to propel learning is by embracing digital resources – technologies. PBS (15-20, 2013) statistical report of a survey spanning 503 web-based interviews with US pre-k-12 teachers on how teachers are utilizing technology in America's classrooms, shows that 74% of teachers say that Educational technology is a student motivator, over two-third of teachers want more classroom technology and up to 75% of teachers teach in low-income schools. The report highlighted that most teachers use various technology resources; 48% use online lesson plan, 45% use web-based interactive games and activities, 44% use websites to deliver class information and 43% use online video, images and articles. The rate of usage can be owed to the numerous benefits it has yielded over the years. Educational technology has also proven beneficial by serving as a medium of reinforcement and expansion of course content, motivating students to learn through participative methods, flexible in responding to variety of learning, doing much more than ever for students and aiding teachers in demonstrating concepts which cannot be shown in the classroom. For example, teachers are not only faced with the task of managing productivity but also challenged with the responsibilities of creating new and exciting possibilities for the students (Weimer, 2001). This particular reason has led to the high demand of the need of developing teachers' technological pedagogical content knowledge, which has been a trendy subject for researchers today. Researchers have also been exploring various areas of technological pedagogical content knowledge such as TPACK level investigation, developing model of measurements, instruments and validation, constructs developments and so forth. (Chai et al., 2010; Jang and Tsai, 2013; Lin et al., 2012; Koh et al., 2013; Koh et al., 2014; Mishra and Koehler, 2006; Schmidt et al., 2009).

2.1.2 Purposes for Integrating Technology in Teaching

According to Abik and Ajhoun (2012), technology integration in learning process have revealed new opportunities of learning which has served as a medium of communication and dissemination of pedagogical contents, but without effective integration of pedagogy and content, there will be no remarkable results. In other words, technology should be viewed in conjunction with pedagogy and content for effective learning outcomes. Such outcomes are been experienced by the:

i. **Collaborative learning improved through computer-mediated context:** Collaborative learning also means cooperative learning. Computer mediated environment is one in which communication is achieved by using two or more electronic devices for example computer. In cooperative learning more than one students are situated in an environment with the aim of learning a particular thing. According to Huang, Hsiao, Chang and Hu (2012), it is an organized instructional strategy, which is best for learning in any grade level. In this context, students gain and improve knowledge by working together in a computer-equipped environment. Students engage in this kind of learning via digital content design and other forms of learning which require them to connect to e-learning systems which are platforms provided by the internet to foster communication and engage in discussions with other students. In view of the above, Huang et al., (2012) highlighted that cooperative systems for learning provide necessary functionalities and well-prepared mechanism to support student online teamwork. For example, bulletin, email, computer conferencing, modules for effective learning enhancement, assisting assessment and helping students in their assignments should be used as part of these systems**.**

ii. **Facilitating of Global Learning:** E-learning in the form of distance education has provided learners with the ability to engage and receive lessons from instructors who are not in the same location with them. This is one of the efficient ways of language learning. Native language teachers can teach foreigners their language by videoconferencing. This is advantageous to education since it enables you to get firsthand and more reliable information from the source without having to travel to the location of the instructor (Abik and Ajhoun, 2012; Agyei and Voogt, 2012).

iii. **Reusability of learning object:** Technology systems like the Learning management system (LMS) has helped instructors to create, manage and administer learning objects (instruction materials and contents) from different locations for a long period of time without recreation. These systems have also made revision of these learning materials an easy process (Abik and Ajhoun, 2012; Agyei and Voogt, 2012; Sessoms 2008).

2.1.3 Understanding, Thinking, and Learning with Technology

Technology teaching is different with non-technology teaching environment (Mudzimiri, 2012). In this study, technology teaching means any form of learning or instruction that involves the use of electronic or digital medium such as computers, smart-boards, interactive slides presentations, video, multimedia, and internet among others. Non-technology teaching is learning or instruction done in traditional methods which are the conventional or customary ways of education such as face to face learning, lesson notes, black or white board usage, manual evaluation – hand marking etc. Therefore, the knowledge of understanding, thinking, and learning of a particular subject matter with technology is important when instructors consider technology integration. This is because in as much as learning or instruction has become technology assisted in areas of computation, processing and presentation, the ability to think, structure usage and interpret output is greatly required and expected to be exercised by the instructors and students using the technology whether software or hardware. Planning to design an instruction using technology (articulate – an interactive material making educational software) demands that the instructors understands the software operations, the features that corresponds to these operation and the corresponding actions.

2.1.4 New Terms and Better Efficiency in Existing Pedagogy

Significant use of technology in education brought about new terminologies, which have affected the existing pedagogical approaches positively. It has introduced many changes in the way educational context is perceived. For instance, Educational

Technology has conceptualized technology in socio-environmental context through the utilization of tools, techniques, theories, and methods from multiple knowledge domains. In other words, these has helped to – (1) design, develop, and evaluate human and mechanical resources efficiently and effectively facilitate and leverage all aspects of learning, and (2) guide change agency and transformation of educational systems and practices to add contribution in prompting change in society (Luppicini, 2005).

The term instructional technology is dated back as far as the 90s. The desire to enhance education with technology has existed for thousands of years and has kept this term in the minds of scholars until the 20^{th} century when it emerged. Since the existence of this term, educational researchers have given different views and definitions. In general, this term has not only been seen as a way of solving practical problems through some systematic application of science but has also been viewed as a way of understanding and applying knowledge in order to build and foster a successive structure of knowledge from one generation to another.

> Instructional technology aims to promote the application of validated, practical procedures in the design and delivery of instruction. It is often defined either in terms of media and other technology used (e.g. audio visual media and equipment and computers), or in terms of a systematic process which encompasses instructional design, development, delivery and evaluation. (“Instructional technology,” n.d)

According to Association for Education Communications and Technology (AECT, 1994) Instructional Technology is defined as "the theory and practice of design, development, utilization, management and evaluation of processes and resources for learning" (as cited in Luppicini, 2005). This practice has promoted the integration of teacher and student use and knowledge of tools and techniques directed towards the improvement of student learning in different areas. Instructional materials and methods of instruction has experienced thorough advancements, methodology to teaching has changed from the customary way to more advanced structures and forms that embrace collaboration, new approaches have emerged due to the opportunities and influences technology has created (Abik and Ajhoun, 2012; Luppicini, 2005).

Technology has aided in the development of systems that are used in the automatic ways of acquiring of skills, exploring, saving, recovering and management of data. Considering educational context, it is understood as the implementation of microelectronic tools such as computers to manage, control, and interchange data, internet to explore, save, and recover information for accomplishing educational purposes (teaching and learning) and objectives. Technology has facilitated various ways of aiding teachers to go beyond liner and text-based learning and in discovering new ways to engage students. With these efforts, learning has been transformed from the usual traditional methods i.e. situation where learning is teacher-centered, to a technology-self-contained environment e.g. computer classes with versatility of learning tools that can change how instructors demonstrate concepts, give projects and conduct assessments through adequate knowledge of technology – *technological knowledge* (TK) (Koh et al., 2012). This is using the knowledge of technology tools to enhance learning – *technological pedagogical content knowledge* (TPACK) (Koehler and Mishra, 2009; Koh et al., 2013; Schmidt et. al., 2009).

Technology has ameliorated the quality of learning by supporting, complementing, and fully implementing different pedagogical trends. These have created new pedagogical models that are better than the customary top-down approach i.e. the one-way information transfer from teachers to students. Among such cases are:

- **Behaviorism:** The behaviorist pedagogy is a way of instruction based on the behavioral approach where the teacher depends on the students' observable behaviors in order to prepare an instruction (Abik and Ajhoun, 2012). Such behaviors that can be observed and measured are the students' participation in the class – how the student answers questions, the way the student approach problems – classwork and assignments.

In this method, technology tools such as cameras have aided observation. Since observable traits can be affected by certain conditions over a period, cameras can be used to keep a consistent track of different observed behaviors. This can help the teacher to re-evaluate a particular observation (student behavior) again. This can be useful in pre-service teachers' microteaching sessions (Kuter, 2012).

- **Constructivism:** The constructivist pedagogy is a way of instruction based on the constructivism theory where learning is encouraged by construction. Students actively participate in knowledge construction as they build on their experience (Abik and Ajhoun, 2012; Sessoms, 2008).

In the second method, technology tools such as smart board, videos, audios, computer programs and hardware have been used to engage students into knowledge construction. These tools implement interactivity and have helped to build a more interactive and collaborative environment between the teachers and the students.

The above-mentioned approaches have been implemented in many areas such as in web-based learning and in the development of learning management system and so forth. The ones of which have improved lifelong learning and encouraged two-way or multi-directional learning. It has also helped students to autonomously learn, acquire information and digest them more independently, with their instructors' technological guidance, which encourage them on how to convert those gained information into skills and applicable knowledge.

2.1.5 International Standards for Technology in Education

Due to the increasingly growth of technology integrations in education, it is necessary that instructors acquire accurate skills and behaviors, which are peculiar to digital age professionals. Instructors need to consider comfortably, embracing being co-learners with their students and colleagues around the world. Standards are markers against which other principles can be evaluated. It sets criteria for comparison or to which a certain phenomenon is measured. The reason for standards is in order to ensure adequate use of technology as a tool for applying content knowledge in realistic contexts, for solving problems and making decisions, for exchanging information, and for communicating ideas (NETS, 2000; NETS, 2008). Knowing about a technology is not enough to aid teaching – rather, instructors must devise new ways to create new understanding, solve problems, make decisions, develop products, and communicate effectively using technology. The International Society for Technology in Education (ISTE) focuses on development and application of technology knowledge through the project NETS - National Educational Technology Standards. ISTE Standards (formerly the NETS) for Teachers are the principles for evaluating the skills and knowledge educators need to teach, work and learn in an increasingly connected global and digital society.

According to ISTE National Technological Education Standards for Teachers (NETS, 2000), the performance indicators that teachers should meet are as follows:

i. **Technology operations and concepts:** Instructors should be able to show a sound understanding of technology operations and concepts. The instructor must show introductory knowledge, skills, and understanding of concepts related to technology. There must be a continual development in technology knowledge and skills to keep up to date with current and upcoming technologies (NETS, 2000).

ii. **Planning and designing learning environments and experiences:** Instructors should be able to design and plan effective learning experiences and environment that are technology supported by applying current researches and developing student learning management strategies (NETS, 2000).

iii. **Teaching, learning, and the curriculum:** The instructors implement the methods and strategies for applying technology during the curriculum planning in order to maximize student learning (NETS, 2000).

iv. **Assessment and evaluation:** Students are accessed and evaluated using technology facilitated strategies. Instructors use technology resources to collect and analyze data, interpret results, and communicate findings for better improvement of instructional practice and maximization of student learning (NETS, 2000).

v. **Productivity and professional practice:** Instructors should be able to use technology to enhance productivity and professional practice for example using PowerPoints, and other interactive software like Articulate to improve interaction and students' motivation, use technology systems like wiki and web portals to communicate and collaborate with peers, parents, and the larger community in order to nurture student learning (NETS, 2000).

vi. **Social, ethical, legal, and human issues:** Instructors should be able to understand social, ethical, legal, and human issues surrounding the use of technology usage and apply the understanding in practice. For example, copyright and piracy issues (NETS, 2000).

Some other resources to help teachers learn about the ISTE Standards and how to use them are as follows:

A. **NETS for Teachers advancing digital age teaching:** it states that an effective instructor in the digital age should be able to meet the 5 standards and performance indicators highlighted below (NETS, 2008):

   i. Facilitate and inspire student learning and creativity
   ii. Design and develop digital-age learning experiences and assessments
   iii. Model digital-age work and learning
   iv. Promote and model digital citizenship and responsibility
   v. Engage in professional growth and leadership

It added that effective teachers should model and apply the ISTE Standards for students as they design, implement, and assess learning experiences to engage students and improve learning; enrich professional practice; and provide positive models for students, colleagues, and the community.

B. **Essential conditions:** highlighted 14 necessary conditions to effectively, leverage technology for learning. They are:

i. Shared vision
ii. Empowered leaders
iii. Implementation planning
iv. Consistent and adequate funding
v. Equitable access, skilled personnel
vi. Ongoing professional learning
vii. Technical support
viii. Curriculum framework
ix. Student-Centered Learning
x. Assessment and evaluation
xi. Engaged communities
xii. Support policies and supportive external context (NETS, 2008).

2.2 Technological Pedagogical Content Knowledge (TPACK) in Education

TPACK framework is always being referred to as an extension of Shulman's idea of Pedagogical Content Knowledge (PCK) (Chai et al., 2013; Koehler and Mishra, 2005). Shulman highlighted that considering only teachers' content knowledge or pedagogical knowledge (Figure 1) will be insufficient for describing their knowledge of teaching and also cannot be able to address the learning needs of the students. Shulman went further to buttress this point by suggesting that in order to construct a good, strong and sound pedagogical teaching tactics, which will aid students' learning of difficult subject matter (Shulman, 1994), both sources of knowledge (PK and CK) should be combined (Mishra and Koehler, 2006; Shulman, 1994). This gave birth to new concept for teaching known as Pedagogical Content Knowledge – PCK (Figure 2). The ability to bring together deep knowledge of a subject matter (CK) with profound understanding of what is good to be learned (PK) under the same domain makes an expert teacher. The 20th century instructors had the knowledge of Pedagogical Content Knowledge (PCK) framework, which comprises only of 3 components CK, PK, PCK.

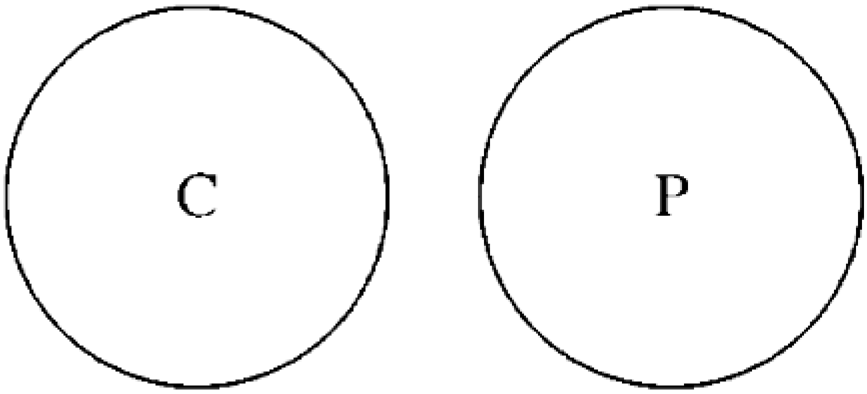

Figure 1. Two Circles Representing Pedagogical and Content Knowledge.

Shulman (1994) expressed the need for an elaborated and extended understanding of teachers' content knowledge by trying to categorize the content knowledge in the teachers' mind, and checking the existing relationships between content knowledge and pedagogical knowledge. Shulman (1994) encouraged the combination of content and pedagogy domains rather than independently looking at a specific domain (Jang and Tsai, 2013). This was how pedagogical content knowledge (PCK) was formed. Shulman highlighted PCK to signify the combination of content and pedagogy on thoughtful knowledge of the ways specific subject matters and issues are systematically organized, denoted and adjusted to the various abilities and interest of learners, and offered for teaching (Kazu and Erten, 2014).

Mishra and Koehler (2006) achieved a step further on the issue Shulman expressed by developing a more elaborated and extended framework, TPACK (Technological Pedagogical Content Knowledge). The concept of technological pedagogical content knowledge (TPACK) formerly known as TPCK *(see section 2.1.3)* was derived from Shulman's PCK framework (Jang and Tsai, 2012; Jang and Tsai, 2013; Koh and Chai, 2014; Koehler and Mishra, 2009; Mishra and Koehler, 2006; Schmidt et al., 2009). Over the years researchers have explained Technological Pedagogical Content Knowledge (TPACK) in various ways, from these explanations different definition of TPACK has been derived. Koh et al. (2013) defined TPACK as a theoretical framework that describes teachers' expertise for information and communication integration. Jang and Tsai, (2013) defined TPACK as a consolidated knowledge system that promotes students learning. Niess, (2005) defined TPACK as the integration of subject matter knowledge development with the development of technology and the development of teaching and learning knowledge. Mishra and Koehler, (2006) defined TPACK as a way of thinking about the knowledge teachers need to understand to integrate technology effectively in their classrooms.

Chai et al. (2013), in an investigation of 74 journal papers that dealt with ICT integration from TPACK, highlighted that TPACK is the type of consolidative and transformative knowledge needed by instructors for efficient and effective technology usage in classrooms. They stated that TPACK framework tends to address the problems caused by too much emphasis on technological knowledge in majority of information and communication technology courses that are isolated from the teachers' subject matter learning and pedagogical training during lessons. This concern has made TPACK a growing research area with more scenarios of implementation in the North American region.

Agyei and Voogt (2012) research study on developing TPACK in pre-service mathematics teachers through collaborative design was conducted in the University of Cape Coast, Ghana. The study consisting of 125 participants in which 90 were males and 35 females between the ages of 19 and 37, presented TPCK as a useful analytical lens for studying teachers' integration of technology, content, and pedagogical knowledge, as it progresses over the period of time in a learning by doing setting and also verified TPCK as a potential frame for technology integration development for teachers.

This study conducted by Lin et al. (2013) focused on ascertaining science teachers' perceptions of TPACK. The study consisted of 222 participants (pre-service and in-service teachers) in Singapore. The study showed that science female teachers have higher perception in pedagogical knowledge (PK) but in technological knowledge (TK) expressed lower perception than males. They also found that the TK (Technological Knowledge), TPK (Technological Pedagogical Knowledge), TCK (Technological Content Knowledge), and TPC (Technological Pedagogical Content), opinions of female in-service science teachers significantly and negatively correlated with their age.

In the 21st century, in every field of education, technology has provided new ways to access and process knowledge (Chai et al., 2013). This is information and communication technology integration. Due to the increase in technology integration, Mishra and Koehler (2006) supplemented Shulman's ideas by introducing a third component to the framework called technology knowledge. This is the knowledge considered when describing teachers' know-how for technology integration.

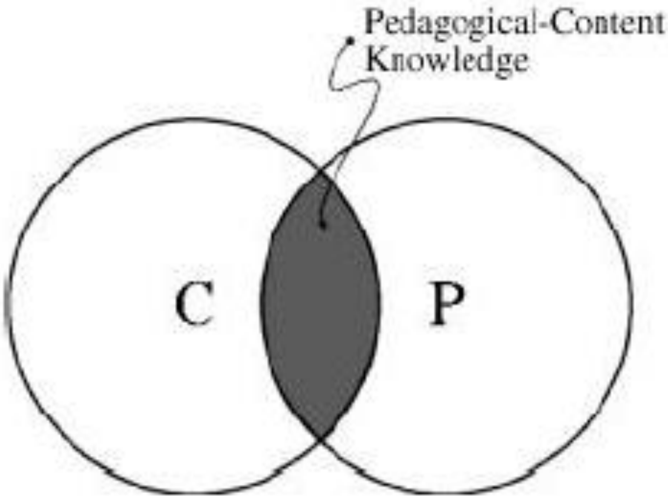

Figure 2. Intercepting of CK and PK to form Pedagogical and Content Knowledge (http://www.tcrecord.org).

2.2.1 TPACK Framework

Over the years the technology take-over in the educational sector has led to so many researches, development, inquiries on the most beneficial ways technology can be incorporated to make students' learning efficient and effective by the instructors, stakeholders in education, and policy makers (NETS 2000, 2008). This change continued in such a way that technology is now viewed not as content but as an instructional instrument (Koehler and Mishra, 2005; Mishra and Koehler, 2006; Niess, 2005; Niess, 2006) i.e. technology was not to be limited in usage by only using it to develop learners' technological abilities especially computer skills, rather to develop the learners' ability to grasp concepts through the use of technology. When the investigation on the kind of knowledge required to use and implement ICT in instruction began in the 21st century by some researchers (Koehler and Mishra, 2005; Mishra and Koehler, 2006; Niess, 2005; Niess, 2006), very important questions were highlighted by Niess (2006) concerning the kind of knowledge required by an instructor for development in order to effectively teach mathematics and quoted: "What will these teachers need to know and be able to do?" Niess (2006) indicated that the teachers who teach mathematics were not trained using technology tools, therefore, this arises a concern on how to identify the required tools and prepare teachers to teach mathematics in the 21 century. But this concern do not only affect mathematics but concerns all subject area, to that effect Koehler and Mishra (2005) highlighted a similar question: "What do teachers need to know about technology and how can they acquire this knowledge?"

These researchers debated that instructors need to develop a sense of knowledge structure that allows for the incorporation of subject matter knowledge, pedagogy knowledge, technology knowledge in curriculum, and schools; that instructors are required to develop a pedagogical content knowledge in order to deliver their subjects (Koehler and Mishra 2005; Mishra and Koehler 2006; Niess, 2005). Many other questions were raised like the one by Niess; "is technology going to be a tool or an integral component for learning and communication within mathematics context as termed by the NETS for Students?" Are the students going to be learning various technologies alongside when learning mathematics with technologies? Are the students going to be actively engaged in mathematics with the usage of technologies as productivity, communication, research and problem-solving and decision-making tools? (Niess, 2006).

These questions and more brought the understanding of the necessity of technology PCK i.e. pedagogical content knowledge that has technology. This implies that technology should not be considered separate and independent from PCK but should be seen as important as others within the context of teaching (Koehler and Mishra, 2005; Mishra and Koehler, 2006; Lin et al., 2013).

Most of the recent research on TPACK started with the aim of providing efficient and effective ways for pre-service teachers to integrate technology due to the rampant disorganization technology integration has experienced over the years. This issue can be said to have occurred because of the absence of a uniform appropriate teacher knowledge framework. Today, it is not just only for pre-service teachers but also for in-service teachers. Old systems need to be perfected, efficiency needs to be maintained and so forth. A framework to monitor teachers' technology know-how and training guidance is needed. As of 2005, Mishra and Koehler introduced a conceptual framework called technological pedagogical content knowledge (TPACK) to the educational research community. Researchers have welcomed the framework with significant initial excitement, as evidenced by the rapid growth of special interest groups (Graham, 2011).

Technological Pedagogical Content Knowledge (TPACK) has proven to be that framework, since the introduction of technology causes the representation of new concepts and requires developing sensitivity to the dynamic, transactional relationship between all three components suggested by the TPCK framework. Koehler and Mishra (2005) described the relationship between content, pedagogy and technology, in addition with Shulman conception of Pedagogical Content Knowledge (PCK) and went further to conduct an in-depth analysis of the complex interaction of these components. The addition of technology in this analysis gave rise to four more components TK, TPK, TCK, and TPACK. This framework strongly holds that effective integration of technology into instruction can be achieved when knowledge of content, pedagogy and technology are integrated as one entity or a system rather than separated entities.

Framework relationship: K (P + C) = PCK; T (PCK) = TPCK = TPACK

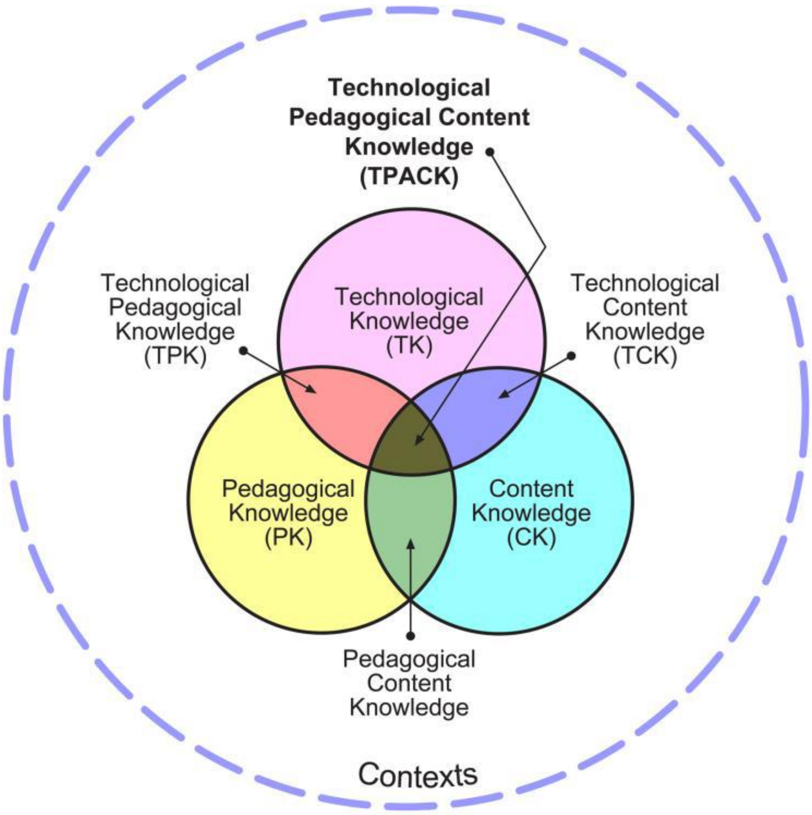

Figure 3. TPACK framework (graphic from http://tpack.org)

Figure 3 above shows the TPACK framework represented with a Venn diagram with three overlapping circles, each representing a distinct form of instructor knowledge domains (Graham, 2011) which are three major components that are interconnected together namely Content (C), Pedagogy (P) and Technology (T). According to Schmidt et al. (2009), at the intersection of these components lies a spontaneous understanding of teaching subject matter with appropriate pedagogical methods and technologies. The interconnection between these three components brings about the formation of additional new knowledge domains; Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK) including Shulman's Pedagogical Content Knowledge (PCK) to make a total of three domains. The interconnection of the three major components and the newly formed knowledge domains forms the last knowledge domain – Technological Pedagogical Content Knowledge (TPACK).

2.2.2 Components of TPACK Described

Altogether there are seven components that make up the TPACK framework (Koehler and Mishra, 2005). They are described below:

Content Knowledge (CK) also known as subject expertise (Shulman, 1994) is the knowledge about a particular subject matter (Koh et al., 2013) that is to be learned or taught (Mishra and Koehler, 2006; Mishra and Koehler, 2008; Koehler and Mishra, 2005; Koehler and Mishra, 2009; Schmidt et. al., 2009). It is the knowledge about a subject that is learned, exercised, or taught over a period of time. For example the knowledge about instructional design, Database management, programming courses

(HTML5, C, C++ or PHP). This is the knowledge an instructor has about a particular subject matter.

Pedagogical Knowledge (PK) is the in-depth knowledge of teaching methods, practices strategies and procedures (Mishra and Koehler, 2006; Mishra and Koehler, 2008; Koehler and Mishra, 2005; Koehler and Mishra, 2009; Koh et al., 2013). It refers to the processes and methods of teaching, which includes knowledge of classroom management, lesson plan development, assessment and student learning (Schmidt et. al., 2009). It is the knowledge of how to transfer or communicate the content knowledge. Depending on the pedagogical purpose of the teacher, different methods are embraced in order to bring out the desired student behaviors and to support students' learning (Kazu and Erten, 2014).

Technological Knowledge (TK) is the knowledge of technology tools (Koh et al., 2013) such as computers, the internet, digital video, and more commonplace technologies including overhead projectors, interactive white boards, software programs and so forth. (Mishra and Koehler, 2006; Mishra and Koehler, 2008; Koehler and Mishra, 2005; Koehler and Mishra, 2009; Schmidt et. al., 2009).

Technological Content Knowledge (TCK) is the knowledge of how to use technology to represent a subject matter. This is the understanding of technology impact on representing content which provides flexibility of technology use for educational purposes in order to influence the way students practice and understand the concept of a particular subject matter (Mishra and Koehler, 2006; Mishra and

Koehler, 2008; Koehler and Mishra, 2005; Koehler and Mishra, 2009; Kazu and Erten, 2014; Schmidt et. al., 2009).

Technological Pedagogical Knowledge (TPK) is the knowledge of how to use technology to implement or adopt different methods (Mishra and Koehler, 2006; Mishra and Koehler, 2008; Koehler and Mishra, 2005; Koehler and Mishra, 2009; Koh et al., 2013; Schmidt et. al., 2009).

Pedagogical Content Knowledge (PCK) is the knowledge of how a subject matter is to be taught. This includes methods and processes to deliver a specific content. According to Shulman this knowledge helps the learning of all subjects as it provides ways of organizing, representing and adapting different interest and skill of learners (Mishra and Koehler, 2006; Mishra and Koehler, 2008; Koehler and Mishra, 2005; Koehler and Mishra, 2009; Koh et al., 2013; Schmidt et. al., 2009).

Technological Pedagogical Content Knowledge (TPACK) is the knowledge, which arises from the blending of technology, pedagogy and content. It is the knowledge required by instructors to use technology to implement teaching methods or processes in any subject matter (Koehler and Mishra, 2009; Koh et al., 2013; Schmidt et. al., 2009). Its goes beyond techno-centrism because it helps teachers in effective and creative thinking (Kazu and Erten, 2014).

2.2.3 The Change – from TPCK to TPACK

For over three years since the TPACK was formed – from 2005 to 2007, it was abbreviated as TPCK, where "T" represents Technology, "P" represents Pedagogy, "C" represents Content, and "K" represents Knowledge. Until 2007, Thompson and

Mishra (2007) saw the need for this change and highlighted 2 main reasons for it which are;

1. Undergraduate students and pre-service teacher are put off by the pronunciation.
2. The acronym being heavy with consonants, in order to have better pronunciation there has to be a vowel.

At the 9th Annual National Technology Leadership Summit in 2007-2008, TPCK was renamed to TPACK (Thompson and Mishra, 2007). Participants at the summit created name suggestions and after many considerations TPACK emerged as the perfect substitute – “A” was introduced to TPCK. This change as good as it sounds, has not been easy going through adoption process because everyone, according to (Voogt, et al., 2013), has not adopted it. The renaming of TPCK created a cause of confusion amongst researchers and publishers in education technology. Although Thompson and Mishra (2007) stated two key aspect of the renaming;

- Firstly, it puts emphasis on the three kinds of knowledge (Technology, Pedagogy, “and” Content) which are the necessary building blocks of an intelligent and solid technology integration.
- Secondly, it gives a detailed understanding through which the three knowledge domains is viewed always as a whole and in a whole “Total Package”, or rather as a system but not in isolation.

It was viewed as a “Total Package” for aiding teachers to take the benefit of technology for students’ learning improvement but it succeeded in leaving the researchers on their own to decide the real value of “A” in the acronym, whether as just a vowel, as the first key aspect insinuated or as a Total Package as second key aspect. This is not very good for the educational research. However, the developers of this framework (Koehler and Mishra, 2005; Koehler and Mishra, 2009; Mishra and Koehler, 2006; Mishra and Koehler, 2008; Niess, 2005, Niess, 2006; Niess et al, 2009) were not definite about “A” to represent “And” except for Koehler and Mishra (2009) contradiction by using “A” to mean “and”. Since the knowledge teachers required for the development of effective technology integration is the purpose of TPACK then having “AND” – Technology Pedagogical and Content Knowledge implies the following:

a. The components are supposed to be interconnected with each other rather than viewed as an independent components by application (Mishra and Kohler, 2006) but in this case it might look and sound like a list rather than a whole system.

b. It might sound like an hierarchy having emphasis placed on technology first then followed by pedagogical before content which is contrary to the aim of TPACK (Jang and Tsai, 2012; 2013; Koh and Chai, 2014; Koh et al., 2013; Koehler and Mishra, 2005; Koehler and Mishra, 2009; Mishra and Koehler, 2006; Schmidt et al., 2009). In this case, the main point is to support learners in the comprehension of various ideas, principles, and theories and understand concepts and so forth. (Niess 2005; 2006) and not to distinguish which components are superior over the other.

c. It presents TPACK framework as an inseparable structure (Thompson and Mishra, 2007), which is why ‘A’ should be considered not as ‘AND’ but rather as an aid to make TPACK (Tee - PACK) what it should be – a Total Package.

Though, the difficultness of pronunciation for researchers and instructors when illustrating TPCK to pre-service and in-service instructors has become so discussed and that has been the obvious reason of the change.

Koehler and Mishra (2005), wanted to understand the outcome of teachers designing educational technology as a form of TPACK improvement. They argued that the authentic design-based activities could aid the development of TPACK. The seminar design consisted of 4 faculty members and 13 students. After the design seminar, it was found that the participants' knowledge of technology and their TPACK were developed. Therefore making "learning by design" an effective instructional technique to develop deeper understanding between content, pedagogy, technology and the context, which they function.

2.3 Related Researches Studies

Since the conception of TPACK, so many research studies have been conducted. This section highlights the summary of various researches and their findings.

As explained previously, based on Shulman's idea, Mishra and Koehler (2006) moved a step further on the development of an extended framework - Technological Pedagogical Content Knowledge that would help teachers know and manage the kind of knowledge needed in order to integrate technology successfully in teaching. This framework was intended to help understand and simplify the complexity of teaching and addresses areas where challenges have been encountered according to Koehler and Mishra (2009).

Koehler and Mishra (2009) study highlighted some challenges teachers face while teaching with technology by asking “What is Technological Pedagogical Content Knowledge?”. These challenges emerged from: Firstly, the view of those digital technologies are protean (usable in many different ways); unstable (rapidly changing); and opaque (the inner workings are hidden from users) compared to traditional pedagogical technologies. Secondly, from the unclear understanding of the affordances and constraints of specific technologies and how they influence teachers’ teaching in classrooms. Lastly, from the issues that emerge when considering social and contextual factors. Through these challenges Koehler and Mishra (2009) seek to find an approach to thinking about technology integration from which they proposed TPACK framework. In this study, they stated the necessity to include technology integration into the kind of knowledge a teacher needs to consider when teaching. This would help to describe better these types of knowledge and how they are implemented and instantiated in practice. Koehler and Mishra’s study offered the possibilities of promoting research in three teacher related areas and helping teachers see technology beyond the scope of “add-on”.

This development has served as a lens for many other research studies as seen in Wentworth, Graham, and Monroe (2009) handbook on “TPACK Development in Teacher Education Program”. The goal of this research was for candidates to be able to complete a “Teacher Work Sample” via three stages of TPACK development, which must contain a technology component by following consistent criteria for how technology should be appropriately used in active learning in each stage. Wentworth et al., (2009) discovered that at the third stage teacher candidates failed in translating the knowledge of technology (stage 1) and method course (stage 2) into teaching practice (stage 3). To further investigate the reason for this failure, 22 interviews were conducted and mentored. It was found that the mentors for the teacher education program guided the candidates into using technology to produce lesson materials and present information to their students instead of producing pedagogy that includes inquiry learning with technology. They concluded that integration of technology would be enough if teachers and the people mentoring and assessing field experiences share the same high expectations.

Jang and Tsai (2012) explored the TPACK of 818 Taiwanese elementary school mathematics and science schoolteachers with respect to the use of interactive white boards (IWB). They developed and validated the IWB-based questionnaire, which contained 5 items under each category. Their findings showed that there were significant differences in the TPACK of elementary teachers who used IWB compared to those who do not use. Science teachers' knowledge associated with the technology-related components of TPACK was found to have high significant difference, probably because science teachers involve and make use of more technology-related tools in their teaching than mathematics teachers. No significant difference was found according to gender. Jang and Tsai (2012) supported the views of various empirical studies that teachers with more teaching experiences have higher TPACK since their research found high significant difference based on teachers varied amount of teaching experiences (CK and PCKck components precisely).

Another study by Jang and Tsai (2013) explored the TPACK of 1292 Taiwanese secondary school science teachers from 123 secondary schools using a new conceptualized TPACK model. Through a quantitative approach, data was collected by sending the questionnaires by mail. They analyzed the data by conducting *t*-test in order to compare the gender group and ANOVA on the multiple groups of science teachers' experiences. The results of their study revealed that secondary school science teachers' TPACK was statistically significant according to gender and teaching experiences. Considering TPACK subcomponents, it was found that male teachers' TK was significantly higher than the female teachers. They highlighted that science teachers' experience rated significantly higher in CK and PCK in context than the novice science teachers. However, in TK and TCK the novice teachers rated significantly higher than the experienced teachers did. They inferred that this was probably because of the enthusiasm young teachers who began teaching have, towards learning about technology and integrating into their teaching.

Ozgun-Koca, Meagher, and Edwards (2010) study explored the emergence of TPACK in a group of 20 pre-service teachers enrolled in mathematics teaching method course class during which they are to design technology-rich teaching materials in field setting were designed and implemented. This course introduced participants to inquiry based learning with open-ended questioning. They analyzed the quantitative survey response by descriptive analysis and searched for emerging codes and themes in the qualitative data. Ozgun-Koca et al. stated that "In a class where advanced digital technologies were used extensively as a catalyst for promoting inquiry-based learning, pre-service teachers retained a great deal of skepticism about the appropriateness of using technology in concept development roles, despite their confidence that they can incorporate technology into their future teaching". Their findings revealed that participants' understanding of technology shifted from viewing technology as a reinforcement tool into viewing technology as a tool for developing students' understanding.

Kazu and Erten (2014) study was to determine teachers' views on TPACK, their self-efficacy and whether their views changed according to specific variables (eight variables were examined). Their study was conducted with 280 teachers as participants, showed that TK, CK, PCK, TCK and TPACK did not change according to sex while PK and TPK changed. Female teachers were higher in perception compared to male teachers. TK and PCK changed according to age and period of service while others did not. TK and TPK changed according to the faculty graduated from. CK, TPACK, PCK and TCK of classroom teachers were higher than that of branch teachers. Teachers' perception did not change according to the situation of access to internet in the school. Teachers with the use of internet were sufficient having higher levels of TK, TCK, TKP and TPCK. They finally concluded that in-service training received on how to use the internet had more positive effects on CK and PCK, when compared to other dimensions.

Lin, Tsai, Chai, and Lee (2013) examined the relationship between the science teachers' perceptions of TPACK and their demographic characteristics in their study. The participants were 222 in-service and pre-service science teachers. Structural equation models analysis were utilized to examine the model of TPACK consisting of seven factors. These seven factors were confirmed. They indicated that the science teachers' perception of TPC was significant and positively correlated with other TPACK factors. The conclusions drawn from their findings were that female teachers' perception ranked higher self-confidence in pedagogical knowledge but in technological knowledge perceived lower self-confidence compared to the male science teachers. Furthermore, the perception of females teachers in TK, TPK, TCK, and TPC significantly and negatively correlated with their age.

Chai, Koh, and Tsai (2010) in their study examined the perceived development of pre-service teachers as relates to their TK, PK, CK and how such knowledge synthesize. They applied a questionnaire to 889 preservice teachers who entered for the postgraduate diploma (Secondary) in Education. Their pre and post survey findings showed differences between preservice teachers' TK, PK, CK and TPACK that were highly significant. Chai et al. (2010) explained that the previous was because ICT course enhances the teacher's perception of their competencies in using ICT for teaching and learning. Stepwise regression analysis of the pre and post course results revealed that PK had the largest impact on preservice teachers' TPACK.

Neiss et al. (2009) researched on the kind of knowledge that is needed to teach mathematics with digital technologies. They propose a model and standards to help guide teachers, researchers, teacher educators, professional development consultants, and school administrators in the development and evaluation of professional development activities, mathematics education programs, and school mathematics programs. Neiss et al. (2009) proposed Mathematics Teacher TPACK Standards, which offers guidelines for thinking about the above construct, and a Mathematics Teacher Development Model, which describes the development of TPACK towards meeting these standards.

Koh and Chai (2011) described Singaporean preservice teachers' TPACK perceptions relative to its seven constructs. TPACK for meaningful Learning Survey used was distributed to 350 preservice teachers attending compulsory ICT module. Only 214 teachers responded to the web-based survey. Koh and Chai (2011) used stepwise regression model to analyze the comparative influence of gender, age and TPACK constructs on the perceptions of preservice teachers. Age and gender were found with no significant impact. The constructs under study had significant impact on preservice teachers TPACK perceptions of which only TPK and TCK were significant determinants of TPACK.

Archambault and Crippen (2009) examined TPACK amongst 596 K-12 educators in the United States who engaged in online distance education and measured their knowledge with respect to three key domains – technology, pedagogy and content using Tailored Design Survey methodology. Their findings indicated that the knowledge ratings are highest amongst the domains of P, C, and PC, which indicates that the teachers felt good about their knowledge but are less confident when it comes to technology. Correlations among the domains revealed small relationships between T and P domains as well as T and C (.289 and .323 respectively). However, large correlations exist between P and C.

Jamieson-Proctor, Finger, and Albion (2010) carried out an audit on 345 preservice teachers TPACK in order to know how well the teacher education programs prepare graduates with respect to their confidence using TPACK Confidence Survey (TCS). Their results showed that the teachers had high levels of ICT ownership and broadband internet availability but less mobile computing access. The teachers expressed high interest in the use of ICT for both personal and professional purposes but they have low beliefs on the integration of ICT for the improvement of student learning outcomes. The teachers' perceptions of their competence with digital technologies and ICT software applications with word processing, presentation software, email, web browsers and web searching was high (Mean >3). Teachers competency of ICT software applications with multimedia development and authoring, visual thinking software, digital video editing, and web page development and Web 2.0 application was found low (Mean <2 and Mean <3 respectively). Jamieson-Proctor et al. (2010) recommended that audits should be done regulary in order to ensure that preservice teachers have the necessary knowledge bases (TK, PK and TPACK) and confidence to integrate ICT into curriculum.

Kereluik, Casperson, and Akcaoglu (2010) study on TPACK, examined TPACK through a self-report survey to assess individual's Technological Pedagogical Content Knowledge as well as the use of discourse analysis to trace students TPACK throughout a semester long seminar course. They argued that these methods have been limited in measuring individual beliefs and do not identify practical and applied elements of TPACK in pre-service teacher's lesson plans. For this reason, they proposed a lesson-plan coding scheme in order to complement the TPACK survey. Lesson-plan coding scheme offers a way for measuring teachers' practical knowledge and behavior with respect to TPACK. Kereluik et al. (2010) concluding notes admitted that the lesson-plan coding scheme may not be a perfect measure, but it gets closer to assessing teachers' ability to apply their technological, pedagogical and content knowledge to classroom setting than self-report survey data.

Kereluik, Mishra, and Koehler (2011) framed a discussion of new literacy practices that can be enabled through the creative repurposing of digital technologies around TPACK framework since it constitutes of knowledge that instructors require in order to successfully integrate technology in their teaching. Kereluik et al. (2011) highlighted that since teaching with technology demands creative solution a problems arises because most technological tools which are used (Office software, Blogs, etc.) are not designed for instructors, and will need to be repurposed for their needs. They stated that this problem is not a problem if the teachers employ the creative ability of TPACK by developing mind habits that encourage advancement across subject areas, regarding new technological tools and creating new pedagogical approaches. They also stated that acquired ability to consciously subvert signs is a beneficial way of viewing literacy since technology emerges and changes rapidly. Therefore, flexible, creative, and adaptive technological knowledge and technical knowledge of the teacher is required, willingness to experiment and put their technical literacy to work as thoughtful designers of technology and that instructors can design, repurpose technology and ultimately subvert signs advancement.

Chapter 3

METHODOLOGY

The aim of this study is to investigate instructors' views concerning Technological Pedagogical Content Knowledge (TPACK) in the context of their experience at the Faculty of Education. The two questions that this research study sought to answer were:

1. What are the instructors' perceptions with regard to technological pedagogical content knowledge?
2. How do the perceptions of instructors in technological pedagogical content knowledge change according to gender, age, period of service, ranking, employment status, department, and the state of in-service training oriented towards the use of technologies?

Since the study focused on investigating instructors' in their real context and analyzing their current situation of TPACK, a TPACK scale or survey instrument which was developed by Schmidt et al. (2009) was used to obtained the data. All necessary permissions required before the use of the scale were taken.

3.1 Research Design

This study is a quantitative research. Quantitative methods accentuates on objective measurements and numerical analysis of data that are generated through surveys such as polls or questionnaires. According to Aliaga and Gunderson (1999), quantitative research approach is use to explain occurrences via the collection of numerical data which is then interpreted based on mathematical statistical methods. More than collecting numerical data, quantitative methods are used to convert research problems that does not naturally exist in numerical form to a numerical data for statistical analysis, for example, perceptions and attitudes (Aliaga and Gunderson, 1999). It focuses on the collection of numerical data by the means of questionnaires and other object oriented statistical instrument.

This study employed quantitative research in order to statistically investigate and measure instructors' perceived knowledge of Technology Pedagogical Content Knowledge (TPACK), after considering previous studies and survey instruments used by other researches (Chai et al., 2010; Jang and Tsai, 2013; Kazu and Erten, 2014; Koh et al. 2013; Koh et al. 2014; Lin et al., 2013; Schmidt et al., 2009; Shin, Koehler, Mishra, Schmidt, Baran, and Thompson, 2009).

The considered advantages for using this method was because of its scientific composition, easy data analysis, quicker data interpretation, its objective principles (Denscombe, 2010). This was considered important, as this is the first study considering instructors' perceived knowledge at Eastern Mediterranean University Faculty of Education North Cyprus. In order to answer the research questions in this study through chosen research method the TPACK survey instrument was used.

3.2 Participants

The study population consisted of instructors from the Faculty of Education Eastern Mediterranean University North-Cyprus in the academic year 2013-2014 spring semester. Instructors from the Faculty of Education was best sample for this research because they are the bedrock of education and mothers of the pre-service instructors. The researcher wanted to build the context of this study around those who are often in the business of creating and thinking about effective ways of pedagogy in order to aid good connections between technology and pedagogy (Elçi, 2012; Mishra and Koehler, 2008). The instructors' the instructors' demographic information is shown in Table 1 below:

Table 1. Instructors' Demographic Information Frequencies

	Frequency (f)	Valid Percent (%)
Gender		
Male	25	47.2
Female	28	52.8
Total	53	100
Age		
21-25 years	2	3.8
26–30 years	5	9.4
31–35 years	9	17.0
36–40 years	8	15.1
41–45 years	6	11.3
over 46 years	23	43.4
Period of Service		
1-5 years	12	22.6
6-10 years	6	11.3
11-15 years	6	11.3
16-20 years	8	15.1
21 years and above	21	39.6

Table 1. *(continued)*

Ranking		
Prof. Dr.	14	26.4
Assoc. Prof. Dr.	6	11.3
Assist. Prof. Dr.	15	28.3
Sen. Instructor	14	26.4
Instructor	1	1.9
Res. Assistant	3	5.7
Employment Status		
Fulltime	38	71.7
Part-time	15	28.3
Department		
CITE	10	18.9
EE	5	9.4
ELT	9	17.0
ES	25	47.2
TLT	4	7.5
In-service Training		
Yes	45	86.5
No	7	13.5

From Table 1 above, the participants were 53 instructors (52.8% of them were females and 47.2% of them were males) from various departments in the Faculty of Education. Instructors were selected from this department because of the important position they occupy in modelling of learning. Due to their already gained knowledge about pedagogy and content knowledge, they will better understand the need for the study, thereby enabling the researcher to obtain reliable results for this study.

According to age of the instructors in Table 1, 3.8% were between the ages of 21-25 years, 9.4% were between the ages of 26-30 years, 17.0% were between the ages of 31-35 years, 15.1% were between the ages of 36-40 years, 11.3% were between the ages of 41-45 years, and 43.5% were over 46 years of age.

Based on the data collected, 22.6% of the instructors have been in-service between the periods of 1-5 years, 11.3% of the instructors have been in-service between the periods of 6-10 years, 11.3% of the instructors have been in-service between the periods of 11-15 years, 15.1% of the instructors have been in-service between the periods of 16-20 years and 39.6% of the instructors have been in-service between the periods of 21 years and above (see Table 1).

According to ranking of the instructors in Table 1, 26.4% ranked Prof. Dr., 11.3% ranked Assoc. Prof. Dr., 28.3% ranked Assist. Prof. Dr., 26.4% ranked Senior Instructor, 1.9% ranked Instructor and 5.7% ranked Research Assistant.

The research study was conducted the six departments. Out of 73 instructors response were gotten from 53 instructors' (71.7% are fulltime instructors and 28.3% are part-time instructors) in five departments only; 18.9% were from Computer Education and Instructional Technologies (CITE), 9.4% were from Elementary Education (EE), 17.7% were from English Language Teaching (ELT), 42.3% were from Educational Sciences (ES) and 7.5% were from Turkish Language Teaching (TLT). No response was gotten from Fine Arts Education (FAE). According to in-service training oriented to the use of technology, 86.5% agreed that they have received such training while

13.5% disagreed. Every participant in this study completed the TPACK questionnaire to report his or her opinions and experiences regarding TPACK.

3.3 Data Collection Instrument and Analysis

The TPACK survey instrument is a questionnaire developed by Schmidt et al. (2009). Schmidt et al. (2009), Technological Pedagogical Content Knowledge (TPACK): The Development and Validation of an Assessment Instrument for Preservice Teachers, presented the development of a survey instrument, which has been used by most of the researchers focusing on this subject for over five years now. This instrument, which they developed, contained questions addressing demographic and 75 items for evaluating preservice teachers' personal assessments of the seven TPACK domains: 8 TK items, 10 PK items, 17 CK items, 8 PCK items, 8 TCK items, 15 TPK items, and 9 TPACK items. The survey instruments used by Kazu and Erten (2014), Schmidt et al. (2009) and Koh et al. (2013) were reviewed, which helped the researcher to develop a more comprehensive list of items suitable for this study. According to Kazu and Erten (2014), the survey instrument used was mainly adapted from Schmidt et al. (2009), therefore only the items of the survey instrument by Koh et al. (2013) which was also adapted from Schmidt et al. (2009) was the best choice for this study, because the research was mainly focused on examining practicing teachers' TPACK (see Appendix C). In addition, according to Mathers, Fox and Hunn (2007) questionnaires can be either developed by a researcher or based on an already made index, so the one used by Koh et al., (2013) was chosen. Slight changes were done on the survey instrument to make it suitable this study. These changes are explained in the next section. This survey instrument allowed the instructor self-assess their technological pedagogical content knowledge.

The questionnaire used for this study contained two sections (demographic information and TPACK survey instrument). The first section consisted of 7 items for obtaining the instructors' demographic information while the second section was the TPACK survey instrument used by Koh et al. (2013). The instrument contained 29 items for instructors' self-assessment of their perceived knowledge of TPACK and its related components. The TPACK instrument had 7 dimensions.

The first dimension consisted 6 TK items for assessing technological knowledge, the second dimension consisted of 3 CK items for assessing content knowledge, the third dimension consisted of 5 PK items for assessing pedagogical knowledge, the fourth dimension consisted of 3 PCK items for assessing pedagogical content knowledge, the fifth dimension consisted of 3 TCK items for assessing technological content knowledge, the sixth dimension consisted of 5 TPK items for assessing technological pedagogical knowledge and the seventh dimension consisted of 4 TPACK items for assessing technological pedagogical content knowledge (see Appendix C). The 29 items were answered using the following seven-level Likert scale: strongly disagree, disagree, slightly disagree, neither agree nor disagree, slightly agree, agree, strongly agree. Other slight changes were made – "first teaching subject" changed to "teaching subject" in 3 occurrences which are insignificant to the reliability and validity of the instrument. These changes were made in three sections CK, PCK and TCK. Content validity and reliability test was not conducted since other researchers on the instrument have previously done it.

The data collection method used for this study was survey. Mathers et al. (2007) highlighted that surveys are advantageous because their validity are both internal and external and they are flexible, efficient and cost effective. TPACK survey instrument was used for the data collection (see Appendix C). Necessary permissions were also obtained for the usage of the scale, distribution of the survey and from the required population sample (see Appendix D). All questionnaires were distributed to the instructors and the essential data were collected.

The analysis was done with a statistical package called IBM SPSS Statistics version 20. SPSS stands for Statistical Package for Social Scientists (SPSS). It is one of the most popular used statistical tool. It is a very powerful tool and excellent for carrying out statistical analysis. This statistical tool was chosen for this study because of its detail process in analyzing data, ability to generate frequencies, descriptive statistics and so forth.

For this research study, mean, standard deviation, percentage, frequency, non-parametric tests (Mann Whitney U and Kruskal-Wallis test) were determined. The value of significance level *(p)* was taken as 0.05 in the study. Non-parametric test was conducted because majority of the data groups, were not normally distributed and the homogeneity of variance assumption was violated. A non-parametric test was conducted in this study because the variance of the data could not be calculated. Kruskal-Wallis test and Mann-Whitney was used. Below are more of the situations, which were discovered that led to the usage of non-parametric test (Laerd Statistics, 2013):

- The parametric assumption of normality would not be valid for this study since the sample test sizes were less than 30 ($n < 30$). This made the nonparametric test a good option for this study else using the parametric procedure could lead to incorrect conclusions.

- Little was known about the parameters of the interested variables in the population sample.
- If the parameters have, unclear numerical interpretation but has a ranking such as measuring preferences or levels of measurements.

Kruskal-Wallis test was used to find out if there are statistically significant differences between two or more groups of an independent variable on a continuous or ordinal dependent variable while Mann-Whitney test was used to compare differences between two independent groups when the dependent variable is not normally distributed and is either ordinal or continuous (Laerd Statistics, 2013). Both of these are nonparametric tests. Mean to confirm the mean ranks from the nonparametric test were also used.

3.4 Reliability and Validity

According to Koh et al. (2013), the internal reliability was established through high Cronbach alphas for all constructs: TK (a = 0.89), PK (a = 0.94), CK (a = 0.91), PCK (a = 0.94), TPK (a = 0.95), TCK (a = 0.92), and TPACK (a = 0.94). According to Koh et al. (2013), The TPACK survey used contained 30 items, all items loaded significantly with standardized regression weights of at least 0.5 except one PK item, which was excluded. Satisfactory model fit obtained was (x^2 = 1,008.34, x^2/df = 2.88, p < .0001, TLI = .94, CFI = .95, RMSEA = 0.06 (LO90 = 0.06, HI90 = 0.07), SRMR = 0.05).

Chapter 4

RESULTS AND DISCUSSIONS

4.1 Findings

The details below show the instructors' opinions on technological pedagogical content knowledge and the results of the analysis done in order to understand how their opinions about their competencies in technological pedagogical content knowledge change according to the seven demographic information which are gender, age, period of service, ranking, employment status, department, and the state of in-service training oriented towards the use of technologies.

4.1.1 Instructors' Perceptions with regard to TPACK

In regards to the first research question, Table 2 below shows the mean and standard deviations on the instructors' perceived knowledge of TPACK across its 7 dimension.

Table 2. Instructors' Perceived Knowledge of TPACK 7 Dimensions

TPACK Dimensions	**Mean**	**SD**
Technology Knowledge (TK)	5.5641	1.05262
Content Knowledge (CK)	6.5535	.69474
Pedagogical Knowledge (PK)	6.4679	.55601
Pedagogical Content Knowledge (PCK)	5.5660	1.27532
Technological Content Knowledge (TCK)	5.8553	.93028
Technological Pedagogical Knowledge (TPK)	5.8000	.97498
Technological Pedagogical Content Knowledge (TPACK)	5.9118	.83938

Table 2 shows the mean and standard deviation of the 7 TPACK dimensions, according to the instructors self-reports given by the instructors. They were all significantly high. For more compressive details of each item within each dimension, see Appendix A.

4.1.1.1 Technological Knowledge Dimension

The analysis of 6 TK items is presented in Table 3 below;

Table 3. Instructors' Perceived Knowledge of TK Dimension

	TK Items	**Mean**	**SD**
TK1	I have the technical skills to use computers effectively	6.2453	.61724
TK2	I can learn technology easily	6.0189	.97054
TK3	I know how to solve my own technical problems when using technology	5.1509	1.59803
TK4	I keep up with important new technologies	5.5472	1.24909
TK5	I am able to create web pages	4.3654	2.09602
TK6	I am able to use social media (e.g. Blog, Wiki, Facebook)	6.0000	1.30089

In Table 3, out of the 6 TK questions the ability to create web pages TK4 (M=4.3654) ranked the least which suggests that although the instructors see themselves to have high TK, they need more opportunities to use the already gained technology knowledge in solving their own technical problems. This requires that the instructors need to have sufficient knowledge about their own subject areas to be able to develop strategies of application since technology has being an integral part of todays' learning. The analysis of Technology Knowledge TK (M=5.5641, SD=1.05262) dimension in Table 2 indicated that majority of the instructors' perceived TK on the "slightly agree" level. This suggests that the instructors' TK competency is highly significant. Furthermore analysis showed instructors' perceived these items – TK1 (M=6.2453,

SD=.61724), TK2 (M=6.0189, SD=.9705), TK3 (M=5.1509, SD=1.59803), TK4 (M=5.5472, SD=1.24909), TK5 (M=4.3654, SD=2.09602) and TK6 (M=6.0000, SD=1.30089) on different levels.

4.1.1.2 Content Knowledge Dimension

The analysis of 3 CK items is presented in Table 4 below;

Table 4. Instructors' Perceived Knowledge of CK Dimension

	CK Items	**Mean**	**SD**
CK1	I have sufficient knowledge about my teaching subject	6.6226	.65710
CK2	I have sufficient knowledge about my teaching subject like a subject matter expert	6.5472	.66697
CK3	I am able to develop deeper understanding about the content of my teaching subject	6.4906	.91194

In Table 4 out, of the 3 CK questions, they expressed confidence in having sufficient knowledge about their teaching subject CK1 (M=6.6226, SD=.65710) and having sufficient knowledge about their teaching subject like a subject matter expert CK2 (M=6.5472, SD=.66697) as "strongly agree" whereas the ability to develop deeper understanding about the content of their teaching subject CK3 (M=6.4906, SD=.91194) as "agree". This implies that the instructors are fully in control of the content of their lesson and have high level of competences. Therefore, it is concluded that instructors' CK competency on their specific subject areas can be said to appear satisfactory. The analysis of Content Knowledge CK (M=6.5535, SD=.69474) dimension in Table 2 indicated that majority of the instructors viewed their CK level i.e. about their knowledge on their specific subject areas as "strongly agree".

4.1.1.3 Pedagogical Knowledge Dimension

The analysis of 5 PK items is presented in Table 5 below;

Table 5. Instructors' Perceived Knowledge of PK Dimension

	PK Items	**Mean**	**SD**
PK1	I am able to stretch my students' thinking by creating challenging tasks for them	6.5660	.66533
PK2	I am able to guide my students to adopt appropriate learning strategies	6.3962	1.08024
PK3	I am able to help my students to monitor their own learning	6.4340	.69364
PK4	I am able to help my students to reflect on their learning strategies	6.3774	.65710
PK5	I am able to guide my students to discuss effectively during group work	6.5660	.60477

The analysis of PK dimension (Table 5) suggest that the instructors know how to assess student performance in a subject, adopt different learning styles depending on the students' performance, develop learning activities according to what the students understood or not, in a particular context, incorporate different teaching approaches such as project-based learning, questioning learning, collaborative learning, direct learning etc. according to the students learning situations, possesses classroom movement skills and is familiar to the students' common misunderstanding and misconceptions in the teaching subject. Therefore, it is concluded that instructors' perceived PK is satisfactorily sufficient in terms of learning and teaching principles, methodologies, practices, and classroom management. When Pedagogical Knowledge PK (M=6.4679, SD=.55601) was examined, Table 2 showed the overall instructors' perceived PK knowledge to be at the “agree” level. In Table 5, out of the 5 PK questions the instructors indicated their ability to create challenging task to stretch students’ thinking PCK1 (M=6.5660, SD=.66533) and ability to guide their students to discuss effectively during group work PCK5 (M=6.5660, SD=.60477) at the “strongly agree” level, while their ability to “mentor students on ways to embrace suitable learning strategies PCK2 (M=6.3962, SD=1.08024), help them supervise their own learning PCK3 (M=6.4340, SD=.69364) and help students to reflect on their learning strategies PCK4 (M=6.3774, SD=.65710)” were at the “agree” level.

4.1.1.4 Pedagogical Content Knowledge Dimension

The analysis of 3 PCK items is presented in Table 6 below;

Table 6. Instructors’ Perceived Knowledge of PCK Dimension

	PCK Items	Mean	SD
PCK1	Without using technology, I can address the common misconceptions my students have for my teaching subject	5.4906	1.39536
PCK2	Without using technology, I know how to select effective teaching approaches to guide student thinking and learning in my teaching subject	5.6792	1.47770
PCK3	Without using technology, I can help my students to understand the content knowledge of my teaching subject through various ways	5.5283	1.51408

The instructors’ Pedagogical Content Knowledge PCK (M=5.5660, SD=1.27532) competency in Table 2 was found to be at the “agree” level. In Table 6, out of the 3 PCK questions; instructors gave their opinion as “agree” on PCK2 (M=5.6792, SD=1.47770) and PCK3 (M=5.5283, SD=1.51408). On the other hand, the instructors know how to address the common misconceptions of their students without using technology PCK1 (M=5.4906, SD=1.39536) was indicated at the level of "slightly agree" but with M=0.1 away from "agree". Therefore, instructors' knowledge on PCK seems adequate. It is concluded that instructors can teach their specific subject and confidently possess a high level of competency on their specific subject matters from which they take advantage in managing the teaching process.

4.1.1.5 Technological Content Knowledge Dimension

The analysis of 3 TCK items is presented in Table 7 below;

Table 7. Instructors' Perceived Knowledge of TCK Dimension

	TCK Items	Mean	SD
TCK1	I can use the software that are created specifically for my teaching subject (e.g. e-dictionary/corpus for language; geometer sketchpad for maths; data loggers for science)	5.3396	1.73142
TCK2	I know about the technologies that I have to use for the research of content of teaching subject	6.1509	.81798
TCK3	I can use appropriate technologies (e.g. multimedia resources, simulation) to represent the content of my teaching subject	6.0755	.93745

When Technological Content Knowledge TCK (M=5.8553, SD=.93028) was examined and in Table 2, findings indicated instructors' TK competencies was found to be at the "agree" level. In Table 7, out of the 3 TCK questions, instructors gave their opinions on their knowledge of technologies for the use of research and understanding of content of their teaching subjects TCK2 (M=5.3396, SD=1.73142) and their usage of appropriate technologies (e.g. multimedia resources, simulation) to represent the content of their teaching subject TCK3 (M=6.1509, SD=.81798) as "agree". Furthermore, the instructors' usage of software that are created explicitly for their teaching subject (e.g. articulate for instructional material design; geometer sketchpad for mathematics; e-dictionary for languages; data loggers for sciences) TCK3 (M=6.0755, SD=.93745) was found at the "slightly agree" level. These results show that the instructors have high competency levels and possess the required knowledge and understanding of technology, which they use in teaching their students specific concepts in a subject matter.

4.1.1.6 Technological Pedagogical Knowledge Dimension

The analysis of 5 TPK items is presented in Table 8 below;

Table 8. Instructors' Perceived Knowledge of TPK Dimension

	TPK Items	**Mean**	**SD**
TPK1	I am able to use technology to introduce my students to real world scenarios	5.7358	1.17916
TPK2	I am able to facilitate my students to use technology to find more information on their own	6.0566	.92850
TPK3	I am able to facilitate my students to use technology to plan and monitor their own learning	5.7925	1.00687
TPK4	I am able to facilitate my students to use technology to construct different forms of knowledge representation	5.7500	1.15258
TPK5	I am able to facilitate my students to collaborate with each other using technology	5.7358	1.21134

Technological Pedagogical Knowledge TPK (M=5.8000, SD=.97498) which concentrates on how instructors blend learned technologies and teaching activities. The instructors' perceived knowledge on this domain is at the level of "agree" level (see Table 2). In Table 8, all 5 TPK questions – instructors' ability to introduce real world scenarios with the help of technology TPK1 (M=5.7358, SD=1.17916), to facilitate the usage technology to find more information independently TPK2 (M=6.0566, SD=.92850), to facilitate usage of technology to plan and monitor their learning independently TPK3 (M=5.7925, SD=1.00687), to facilitate usage of technology to construct different forms of knowledge representation TPK4 (M=5.7500, SD=1.15258) and to facilitate collaboration within the students using technology TPK5 (M=5.7358, SD=1.21134), were found be the "agree" level. These findings suggests that the instructors have high knowledge in determining the usage of teaching methods and teaching technologies, as well as also good thoughtfulness of arising consequences.

4.1.1.7 Technological Pedagogical Content Knowledge Dimension:

The analysis of 4 TPACK items is presented in Table 9 below;

Table 9. Instructors' Perceived Knowledge of TPACK Dimension

	TPACK Items	**5.9118**	**.83938**
TPACK1	I can teach lessons that appropriately combine social studies, technologies, and teaching approaches	5.9811	1.10053
TPACK2	I can select technologies to use in my classroom that enhance what I teach, how I teach, and what students learn	6.0566	.79458
TPACK3	I can use strategies that combine content, technologies, and teaching approaches that I learned about in my coursework in my classroom	6.0000	.88561
TPACK4	I can provide leadership in helping others to coordinate the use of content, technologies, and teaching approaches at my school and/or district	5.7308	1.15666

Lastly, Technological Pedagogical Content Knowledge TPACK (M=5.9118, SD=.83938) which analyzes the knowledge required by the instructors to use technologies that incorporates content, teaching method and technology tools was found at the “agree” level, see Table 2. In Table 9, instructors perceived knowledge at this dimension shows that they can teach lessons that appropriately combine subject matter, technologies, and teaching approaches TPACK1 (M=5.9811, SD=1.10053), select technologies to use in their classroom that enhance what they teach, how they teach, and what students learn TPACK2 (M=6.0566, SD=.79458), use strategies that combine content, technologies, and teaching approaches that they have learned about in classroom coursework TPACK3 (M=6.0000, SD=.88561) and provide leadership in helping others to coordinate the use of content, technologies, and teaching approaches at school and/or district TPACK4 (M=5.7308, SD=1.15666). This implies that instructors have high level of confidence on TPACK and they can integrate technology sufficiently in teaching.

4.1.2 Instructors’ Opinions on TPACK according to Gender

Mann-Whitney U test was conducted to determine the difference in instructors’ perceived knowledge according to the variable gender across the seven dimensions of the TPACK framework. The results are shown in Table 10.

Table 10. Instructors’ Opinions on TPACK according to Gender

	Gender	N	Mean Rank	Sum of Ranks	U	p
TKTOTAL	Male	24	30.94	742.50	229.500	.050*
	Female	28	22.70	635.50		
CKTOTAL	Male	25	26.22	655.50	330.500	.702
	Female	28	27.70	775.50		
PKTOTAL	Male	25	25.98	649.50	324.500	.642
	Female	28	27.91	781.50		
PCKTOTAL	Male	25	32.52	813.00	212.000	.013*
	Female	28	22.07	618.00		
TCKTOTAL	Male	25	30.48	762.00	263.000	.117
	Female	28	23.89	669.00		
TPKTOTAL	Male	25	29.82	745.50	254.500	.125
	Female	27	23.43	632.50		
TPACKTOTAL	Male	25	28.06	701.50	273.500	.325
	Female	26	24.02	624.50		

*p<0.05

Table 10 displays that there is a significant difference in the instructors’ TK (*MWU*=229.50, *p*<0.05) and PCK (*MWU*=212.000, *p*<0.05) domain across the gender group. It was found that males (M=30.94) had a higher mean rank than females (M=22.70). Therefore, it was found that this difference is in the favor of the male instructors. This was further justified by the high difference discovered between their Mean from the descriptive analysis - Table 11, which implied that male instructors see themselves more sufficient in TK and PCK domain than the female instructors.

According to the findings above, it was concluded that male instructors perceived knowledge was at high level with regard to using technology in teaching process and methods and also in using the teaching processes and methodologies itself.

Table 11. Mean and Standard deviation of Instructors' Opinions on TPACK according to Gender

		N	Mean	SD
TKTOTAL	Male	24	5.8889	.90312
	Female	28	5.2857	1.10634
	Total	52	5.5641	1.05262
PCKTOTAL	Male	25	5.9867	1.18821
	Female	28	5.1905	1.25192
	Total	53	5.5660	1.27532

From the above data, it can be concluded that male instructors in the gender group was statistically significantly higher than the female group in TK (*MWU* = 229.500, p<0.50) and TK (*MWU* = 212.000, p <0.50).

4.1.3 Instructors' Opinions on TPACK according to Age

Kruskal-Wallis test was conducted to determine the instructors' TPACK competency according to the variable age. It was found that there was a significant difference only in TK (p<0.05) domain across all categories of age. Since there were six groups in the age variable, Mann-Whitney U test was carried out between the groups. The significance level is .05.

Table 12. Instructors' Opinions on TPACK according to Age

	Age	N	Mean Rank	Sum of Ranks	U	p
TKTOTAL	21-25 years	2	4.75	9.50	3.500	.571
	26–30 years	5	3.70	18.50		
	Total	7				
	21-25 years	2	7.25	14.50	6.500	.582
	31–35 years	9	5.72	51.50		
	Total	11				
	21-25 years	2	7.25	14.50	4.500	.400
	36–40 years	8	5.06	40.50		
	Total	10				
	21-25 years	2	7.50	15.00	.000	.071
	41–45 years	6	3.50	21.00		
	Total	8				
	21-25 years	2	21.50	43.00	4.000	.065
	over 46 years	22	11.68	257.00		
	Total	24				
TKTOTAL	26–30 years	5	7.40	37.00	22.000	1.000
	31–35 years	9	7.56	68.00		
	Total	14				
	26–30 years	5	7.00	35.00	20.000	1.000
	36–40 years	8	7.00	56.00		
	Total	13				
	26–30 years	5	9.00	45.00	.000	.004*
	41–45 years	6	3.50	21.00		
	Total	11				
	26–30 years	5	19.30	96.50	28.500	.099
	over 46 years	22	12.80	281.50		
	Total	27				
TKTOTAL	31–35 years	9	8.94	80.50	35.500	.963

Table 12. *(continued)*

	36–40 years	8	9.06	72.50		
	Total	17				
	31–35 years	9	10.39	93.50	5.500	.008*
	41–45 years	6	4.42	26.50		
	Total	15				
	31–35 years	9	19.78	178.00	65.000	.147
	over 46 years	22	14.45	318.00		
	Total	31				
TKTOTAL	36–40 years	8	10.50	84.00	.000	.001*
	41–45 years	6	3.50	21.00		
	Total	14				
	36–40 years	8	21.88	175.00	37.000	.016
	over 46 years	22	13.18	290.00		
	Total	30				
TKTOTAL	41–45 years	6	6.50	39.00	18.000	.005*
	over 46 years	22	16.68	367.00		
	Total	28				

*p<0.05

The result in Table 12 shows that there are significant differences between ages 26-30 and 41-45 years (*MWU*=.000, $p<0.05$), 31-35 and 41-45 years (*MWU*=5.500, $p<0.05$), 36-40 and 41-45 years (*MWU*=.000, $p<0.05$), 41-45 and over 46 years (*MWU*=.000, $p<0.05$). This implies that there were differentiations on instructors' perceived knowledge of TK between age ranges. During Mean rank (Table 12) and Mean (Table 13) comparisons, ages 26-30, 31-35, 36-40, over 46 years emerged the highest in each group.

Table 13. Mean and Standard Deviation of Instructors' Opinions on TPACK according to Age

	Age	N	Mean	SD
TKTOTAL	21-25 years	2	6.5833	.58926
	26–30 years	5	6.1000	.81309
	31–35 years	9	5.9630	1.08262
	36–40 years	8	6.1667	.59094
	41–45 years	6	4.0556	.99256
	over 46 years	22	5.3788	.83124
	Total	52	5.5641	1.05262

Further comparison of the mean in Table 13 shows that age range 21-25 years (M=6.5833) has the highest mean. It might be concluded that instructors' TK perceived knowledge is high between 21-25 years but as the instructors age increases, it is discovered that there were fluctuations in the TK knowledge which can be due to some factors. One of these factors can be the lack of interest in TK as the age increases.

4.1.4 Instructors' Opinions on TPACK according to Period of Service

Kruskal-Wallis test was conducted to determine the difference between instructors' perceived knowledge of TPACK according to the variable period of service. Kruskal-Wallis test indicated a significant difference only on the TK ($p<0.05$) domain across the all period of service groups. The significance level is .05. In order to identify on which group the difference occurred, Mann-Whitney U test was carried out. The results of the test is shown below:

Table 14. Instructors' Opinions on TPACK according to Period of Service

	Period of service	N	Mean Rank	Sum of Ranks	U	p
TKTOTAL	1-5 years	12	10.54	126.50	23.500	.250
	6-10 years	6	7.42	44.50		
	Total	18				
	1-5 years	12	11.54	138.50	11.500	.018*
	11-15 years	6	5.42	32.50		
	Total	18				
	1-5 years	12	12.83	154.00	20.000	.031*
	16-20 years	8	7.00	56.00		
	Total	20				
	1-5 years	12	22.54	270.50	47.500	.004*
	21 years and above	20	12.88	257.50		
	Total	32				
TKTOTAL	6-10 years	6	7.08	42.50	14.500	.589
	11-15 years	6	5.92	35.50		
	Total	12				
	6-10 years	6	8.67	52.00	17.000	.414
	16-20 years	8	6.63	53.00		
	Total	14				
	6-10 years	6	15.25	91.50	49.500	.533
	21 years and above	20	12.98	259.50		
	Total	26				
TKTOTAL	11-15 years	6	8.25	49.50	19.500	.573
	16-20 years	8	6.94	55.50		
	Total	14				
	11-15 years	6	14.83	89.00	52.000	.656

Table 14. *(continued)*

	21 years and above	20	13.10	262.00		
	Total	26				
TKTOTAL	16-20 years	8	13.94	111.50	75.500	.823
	21 years and above	20	14.73	294.50		
	Total	28				

*p<0.05

The result in Table 14 indicates significant differences in period of service between 1-5years and 11-15 years (*MWU*=11.500, $p<0.05$), 1-5years and 16-20 years (*MWU*=20.000, $p<0.05$), and 1-5years and above 21 years (*MWU*=47.500, $p<0.05$) in the sub-dimension of TK. Further comparison done using the Mean Rank (Table 14) and the Mean (Table 15) showed that 1-5years (*M*=6.3194 appeared to be the highest in each group. This suggests that when the period of service increases, the TK perceived knowledge levels decreases see Table 15. Also see Figure 4(b).

Table 15. Mean and Standard Deviation of Instructors' Opinions on TPACK according to Period of Service

	Period of service	N	Mean	SD
TKTOTAL	1-5 years	12	6.3194	.68703
	6-10 years	6	5.6667	1.09036
	11-15 years	6	5.5000	.59628
	16-20 years	8	4.9792	1.53384
	21 years and above	20	5.3333	.92875
	Total	52	5.5641	1.05262

The result in Table 15 shows that age range 1-5 years (M=6.3194) has the highest mean. It might be concluded that instructors' TK perceived knowledge is high between 1-5 years but as the instructors period of service increases, it is discovered that there is a drop in the TK knowledge and later on a sharp rise.

4.1.5 Instructors' Opinions on TPACK according to Ranking

The Kruskal-Wallis test conducted to determine the instructors' TPACK competency according to the variable ranking indicated that there were no statistical differences across all categories of the domain. Kruskal-Wallis test indicated that there are no significant differences in any of the domain across the all-ranking groups. The significance level is 0.05.

Table 16. Mean and Standard Deviation of Instructors' Opinions on TPACK according to Ranking

Ranking		TK	CK	PK	PCK	TCK	TPK	TPACK
Prof. Dr.	**Mean**	5.18	6.38	6.50	6.17	5.55	5.77	5.84
	N	13	14	14	14	14	14	14
	SD	1.00	1.12	0.62	1.01	1.28	0.85	0.95
Assoc. Prof. Dr.	**Mean**	5.83	6.50	6.23	5.89	6.39	5.73	6.13
	N	6	6	6	6	6	6	6
	SD	0.80	0.59	0.69	0.93	0.39	0.88	0.85
Assist. Prof. Dr.	**Mean**	5.27	6.67	6.48	5.13	5.98	5.59	5.75
	N	15	15	15	15	15	15	15
	SD	1.10	0.44	0.56	1.43	0.51	0.77	0.87
Sen. Instructor	**Mean**	5.93	6.64	6.51	5.55	5.81	6.18	6.00
	N	14	14	14	14	14	13	12
	SD	1.08	0.44	0.45	1.22	0.89	0.65	0.60
Instructor	**Mean**	7.00	7.00	7.00	3.00	7.00	7.00	7.00
	N	1	1	1	1	1	1	1
	SD	.	.	.	.	.	.	.
Res. Assistant	**Mean**	6.00	6.33	6.33	5.22	5.44	5.07	5.92
	N	3	3	3	3	3	3	3
	SD	0.76	0.58	0.70	1.35	1.39	2.84	1.28

Further comparison of the mean (Table16) across each domain and group showed that there were no significant differences across all ranks and all ranks had high level of competencies. This implies that the TPACK knowledge is evenly distributed across all domains.

4.1.6 Instructors' Opinions on TPACK according to Employment Status

Mann-Whitney U test was conducted to determine the difference in instructors' perceived knowledge of TPACK competency according to the variable employment status across the seven domains of the TPACK framework. The results are shown in Table 17.

Table 17. Instructors' Opinions on TPACK according to Employment Status

	Employment status	N	Mean Rank	Sum of Ranks	U	p
TKTOTAL	Fulltime	37	23.51	870.00	167.000	.025*
	Part-time	15	33.87	508.00		
	Total	52				
CKTOTAL	Fulltime	38	27.21	1034.00	277.000	.862
	Part-time	15	26.47	397.00		
	Total	53				
PKTOTAL	Fulltime	38	25.58	972.00	231.000	.276
	Part-time	15	30.60	459.00		
	Total	53				
PCKTOTAL	Fulltime	38	27.86	1058.50	252.500	.516
	Part-time	15	24.83	372.50		
	Total	53				
TCKTOTAL	Fulltime	38	27.18	1033.00	278.000	.889
	Part-time	15	26.53	398.00		
	Total	53				
TPKTOTAL	Fulltime	38	23.64	898.50	157.500	.024*
	Part-time	14	34.25	479.50		
	Total	52				
TPACKTOTAL	Fulltime	38	25.84	982.00	241.000	.895
	Part-time	13	26.46	344.00		
	Total	51				

*p<0.05

From Table 17 above, a significant difference was determined between fulltime and part-time instructors' perception of TK (MWU=167.000, p<0.05) and TPK

(MWU=157.500, $p<0.05$). These two domains significantly differentiated according to the variable of employment status, and this differentiation was in favor of the part-time instructors. Further analysis was done by using the mean (Table 18). The results are shown below;

Table 18. Mean and Standard Deviation of Instructors' Opinions on TPACK according to Employment Status

	Employment status	**N**	**Mean**	**SD**
TKTOTAL	Fulltime	37	5.3694	1.02825
	Part-time	15	6.0444	.98494
TPKTOTAL	Fulltime	38	5.7000	.78877
	Part-time	14	6.0714	1.36011

According to the results given in Table 18, it was found that each mean comparison between the employment status suggested that the part-time instructors have high-level perception with regards to TK (M=6.0444) and TPK (M=6.0714) that fulltime instructors have in TK (M=5.3694) and TPK (M=5.7000). This implies that all instructors possess a high level of TPACK and its sub-dimension, but the part-time instructors have higher levels of competency. This is may be probably because they spend more time to explore new technologies and find new ways to engage students and make learning effective with them.

4.1.7 Instructors' Opinions on TPACK according to Department

Kruskal-Wallis test was conducted to determine the difference between the instructors' perceived knowledge of TPACK according to their various departments, in which they taught.

Kruskal-Wallis test indicated that there were significant differences across three domains, TK ($p<0.05$), TPK ($p<0.05$), TPACK ($p<0.05$). The significance level is .05. Therefore, Mann-Whitney U test was conducted for each of these domains in order to identify in which group the differentiation occurred. The test was conducted between five departments; Computer Education and Instructional Technologies (CITE), Elementary Education (EE), English Language Teaching (ELT), were from Educational Sciences (ES) and Turkish Language Teaching (TLT).

Table 19. Instructors' Opinions on TPACK according to Department

	Department	N	Mean Rank	Sum of Ranks	U	p
TKTOTAL	CITE	10	10.30	103.00	2.000	.003*
	EE	5	3.40	17.00		
	Total	15				
	CITE	10	13.35	133.50	1.500	.000*
	ELT	8	4.69	37.50		
	Total	18				
	CITE	10	28.20	282.00	23.000	.000*
	ES	25	13.92	348.00		
	Total	35				
	CITE	10	13.30	133.00	12.000	.006*
	ELT	9	6.33	57.00		
	Total	19				
	CITE	10	26.75	267.50	37.500	.001*
	ES	25	14.50	362.50		
	Total	35				
TPACKTOTAL	CITE	9	8.67	78.00	3.000	.020*
	EE	4	3.25	13.00		
	Total	13				
	CITE	9	12.61	113.50	12.500	.011*
	ELT	9	6.39	57.50		
	Total	18				
	CITE	9	23.67	213.00	57.000	.030*
	ES	25	15.28	382.00		
	Total	34				
	*p<0.05					

The results in Table 19 show the significant differences observed between instructors' opinions of TPACK in various departments. The perceived knowledge differentiations occurred in TK groups between instructors who taught in CITE department and those who taught in EE department (*MWU*=2.000, $p<0.05$), instructors who taught in CITE department and those who taught in ELT department (*MWU*=1.500, $p<0.05$), instructors who taught in CITE department and those who taught in ES department (*MWU*=23.000, $p<0.05$), in TPK groups between instructors who taught in CITE department and those who taught in ELT department (*MWU*=12.000, $p<0.05$), instructors who taught in CITE department and those who taught in ES department (*MWU*=37.500, $p<0.05$) and in TPACK groups between instructors who taught in CITE department and those who taught in EE department (*MWU*=3.000, $p<0.05$), instructors who taught in CITE department and those who taught in ELT department (*MWU*=12.500, $p<0.05$), instructors who taught in CITE department and those who taught in ES department (*MWU*=57.000, $p<0.05$). In all the groups, the instructors who taught in CITE department emerged with higher level of competency than other instructors. More details used for the comparisons are presented in Table 20.

Table 20. Mean and Standard Deviation of Instructors' Opinions on TPACK according to Department

	Department	**N**	**Mean**	**SD**
TKTOTAL	CITE	10	6.7000	.39907
	EE	5	5.2000	.69121
	ELT	8	5.2083	.58248
	ES	25	5.3467	1.10859
	TLT	4	5.2500	1.30880
	Total	52	5.5641	1.05262
TPKTOTAL	CITE	10	6.5600	.49710
	EE	4	5.4000	1.21106
	ELT	9	5.5111	.78174
	ES	25	5.6000	1.01817
	TLT	4	6.2000	1.04563
	Total	52	5.8000	.97498
TPACKTOTAL	CITE	9	6.5278	.45833
	EE	4	5.1875	.98689
	ELT	9	5.3056	.94189
	ES	25	5.9400	.72629
	TLT	4	6.4375	.55434
	Total	51	5.9118	.83938

From the data presented in Table 20, comparison of mean in each sub-dimension of the instructors' opinions on their competencies in which significant differences were found was carried out. Computer Education and Instructional Technologies department had the highest mean TK (M=6.7000) TPK (M=6.5600) and TPACK

(M=6.5278). This implies that the instructors in CITE department may be thought to have a higher level of propensity towards the use of technology, adoption of different teaching methods using technology and various kinds of subject matter. Their professional and personal usage of technology compared with other instructors is higher.

4.1.8 Instructors' Opinions on TPACK according to In-Service Training that is Oriented to the Use of Technologies

The results of Mann-Whitney U test on instructors' opinions according to the variable of in-service training that is oriented to the use of technologies such as computers, smart boards, projectors, software programs, digital cameras/videos and others are given in Table 21.

Table 21. Instructors' Opinions on TPACK according to In-service Training that is Oriented to the Use of Technologies

	In-service training	**N**	**Mean Rank**	**Sum of Ranks**	**U**	**p**
TKTOTAL	Yes	46	26.48	1218.00	137.000	.989
	No	6	26.67	160.00		
	Total	52				
CKTOTAL	Yes	46	26.41	1215.00	134.00	.495
	No	7	30.86	216.00		
	Total	53				
PKTOTAL	Yes	46	27.35	1258.00	145.000	.690
	No	7	24.71	173.00		
	Total	53				
PCKTOTAL	Yes	46	25.18	1158.50	77.500	.026*
	No	7	38.93	272.50		
	Total	53				
TCKTOTAL	Yes	46	27.28	1255.00	148.000	.748
	No	7	25.14	176.00		
	Total	53				
TPKTOTAL	Yes	45	26.92	1211.50	138.500	.618
	No	7	23.79	166.50		
	Total	52				
TPACKTOTAL	Yes	44	26.99	1187.50	110.500	.240
	No	7	19.79	138.50		
	Total	51				

*p<0.05

According to Table 21 which has the information of the instructors' receiving in-service training oriented towards the use of technologies, a significant difference was determined between the instructors' competency of PCK (MWU=77.500, $p<0.05$). The differentiation in this sub-dimension was in favor of instructors who gave their response as "No". This may mean that although in-service training oriented towards the use of technologies were conducted, however, they were not directed to affect other sub-dimensions. Further comparisons were done using the mean rank (Table 21) and mean (Table 22) to further understand the result.

Table 22. Mean and standard deviation of instructors' opinions on TPACK according to In-service Training that is Oriented to the Use of Technologies

	In-service training	**N**	**Mean**	**SD**
TKTOTAL	Yes	46	5.5507	1.10379
	No	6	5.6667	.56765
	Total	52	5.5641	1.05262
CKTOTAL	Yes	46	6.5290	.72205
	No	7	6.7143	.48795
	Total	53	6.5535	.69474
PKTOTAL	Yes	46	6.5000	.50022
	No	7	6.2571	.86189
	Total	53	6.4679	.55601
PCKTOTAL	Yes	46	5.4275	1.27398
	No	7	**6.4762**	.89974
	Total	53	5.5660	1.27532
TCKTOTAL	Yes	46	5.8986	.85453
	No	7	5.5714	1.38396
	Total	53	5.8553	.93028
TPKTOTAL	Yes	45	5.8178	.98056
	No	7	5.6857	1.00570
	Total	52	5.8000	.97498
TPACKTOTAL	Yes	44	5.9830	.76515
	No	7	5.4643	1.18523
	Total	51	5.9118	.83938

From the mean (Table 22) results across all domains instructors who agreed receiving in-service training oriented towards the use of technologies were higher than the ones which do not except for PCK. The instructors that said that they do not have in-service training (M=6.4762) were higher than does that had in-service training (M=5.4275). This implies that although in-service training oriented towards the use of technologies has increased the competency of instructors' in TK, CK, PK, TPK, TCK, TPACK domains. It has not made any influence on PCK. This may be because the in-service training given is not sufficient to increase the level of their competencies although not significantly noticed, there were positive effects on PK, TCK, TPK and TPACK when considering the mean and mean rank in Table 21 and 15 above.

4.2 Discussions

The findings presented in this study shows how the instructors perceived TPACK across all the seven components examined; TK, CK, PK, PCK, TCK, TPK and TPACK. The perception level was indicated to be at the "agree" level showing that the instructors have high level of perceived knowledge and competencies.

From the study, it was concluded that the instructors' perception on TPACK changed in TK and PCK knowledge areas, according to gender, whereas there were no changes in the perception on TPACK in CK, PK, TCK, TPK and TPACK according to gender. The result obtained showed that the male instructors had higher level of perception about these two knowledge dimensions in which this change occurred, which was consistent with other research results (Jang and Tsai, 2013; Lin et al., 2013; Koh et al., 2010). Kazu and Erten (2014) stated that female teachers' level of perceived knowledge was found to be higher than that of male teachers. This implies that many instructors had more skills beyond standard technologies and are able to put in operation particular technologies. They also reported higher skills in different ways of interaction in a subject matter and different teaching practices which can enable a student learn the subject matter. Lin et al. (2013) examined the relationship between science teachers' TPACK and gender in their study. Their findings showed that female teachers perceived their PK higher and TK lower than the male teachers, which is consistent with the findings of this study.

In this study, it was found that the instructors' perceptions on TPACK changed in TK knowledge area whereas no change took place in CK, PK, PCK, TCK, TPK, and TPACK knowledge areas according to age and period of service. The results show that when either the age or the period of service increases their TK perception decreases as illustrated from the graph below (Figure 4).

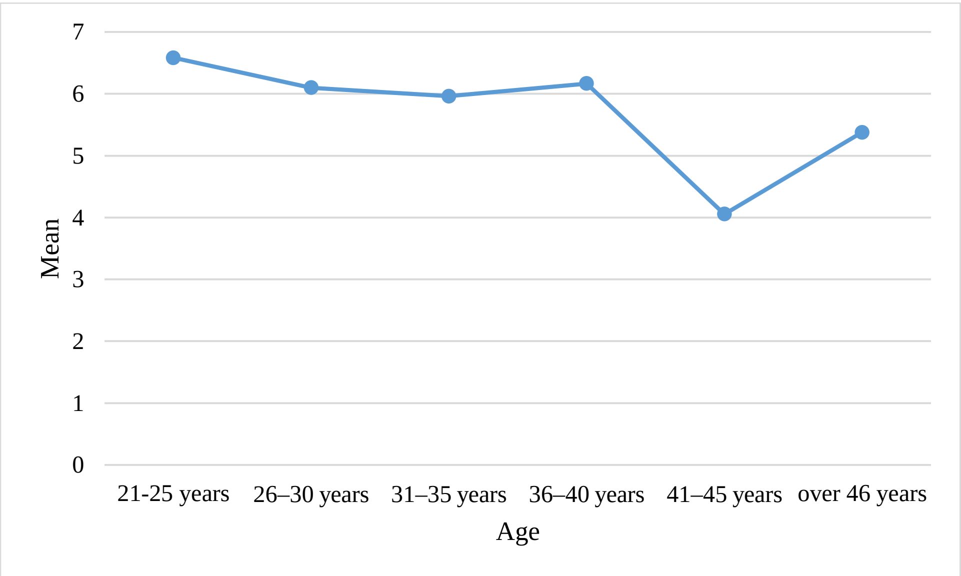

Figure 4(a). TK Mean Progression along Age

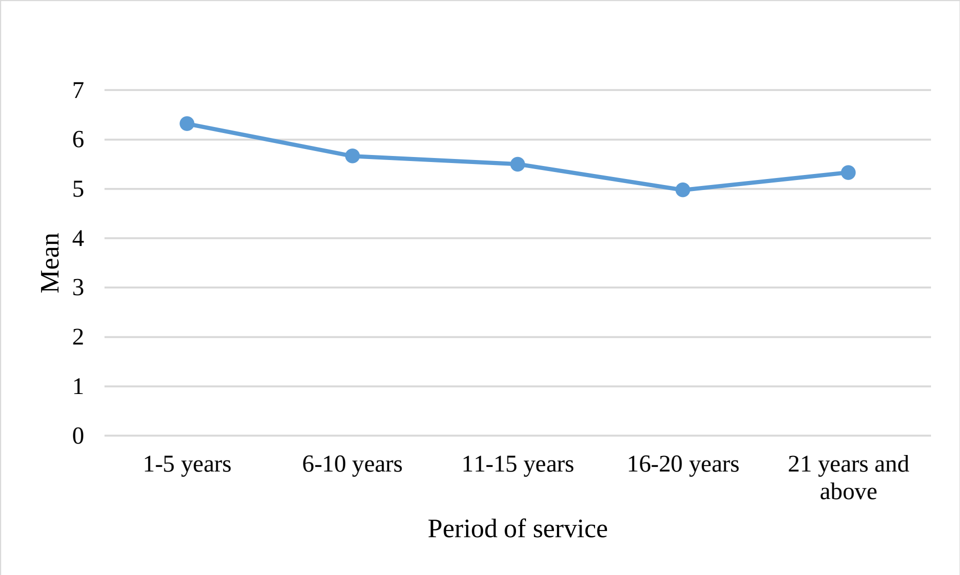

Figure 4(b). TK Mean Progression along Period of Service

Figure 4(a) and (b) illustrate the similarity of progression of instructors' TK perception as age and period either increases or decreases. Across TK age and period of service, the graph forms the same type of shape from which it was concluded that an increment in both would cause TK to decrease. This means that as they grow older and spend more time in their career, they gradually lose interest in technology but they certainly gain more experience in their career specific area. Kazu and Erten (2014) found the same results as they concluded by saying that the interest of the teachers in technology decreases when their age and period of service increases. TK perception increase after decreasing may depend on in-service training oriented towards the use of technologies.

According to the results of this study, there was no significant difference between the instructors' views on TK, CK, PK, PCK, TCK, TPK, and TPACK knowledge areas according to ranking. The knowledge areas were evenly distributed in the ranking, which implies that, the rank of instructors has no effect on the knowledge of the instructors. Figure 5 below explains more graphically.

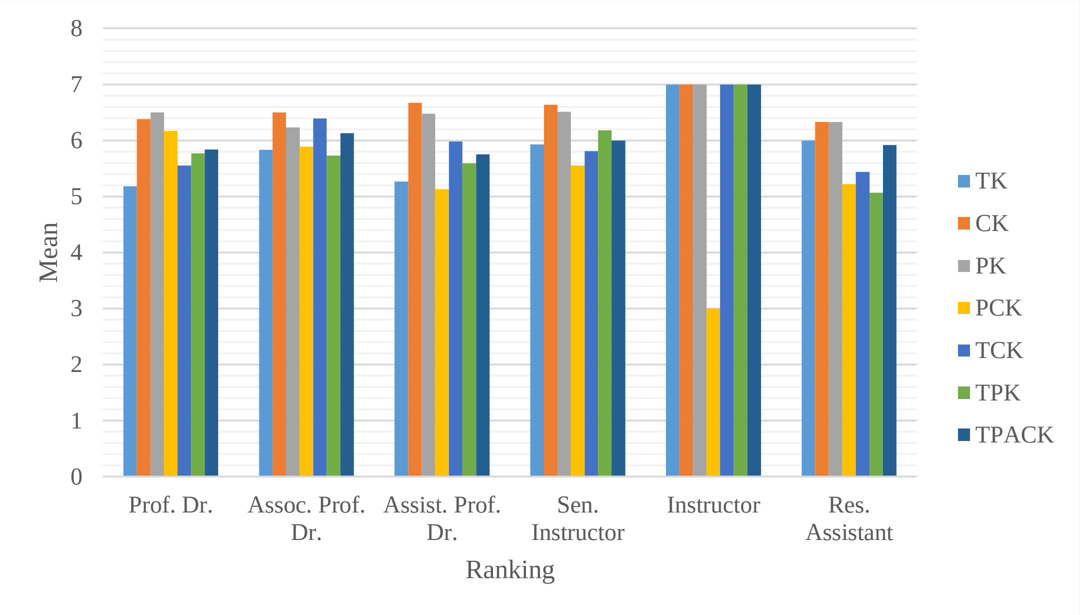

Figure 5. Perceived Knowledge Evenly Distributed across Instructors' Ranking

From the chart (Figure 5), it can be seen that the instructor's perceived knowledge is high; they know how to develop their TPACK, engage TPACK knowledge either through personal or professional use irrespective of their ranking. Koh and Chai (2011) mentioned TPK and TCK as the significant determinants of TPACK. This is same expect that TK as also included according to result of this study. Although no significant difference and identified increase was found in PK, CK and PCK with increase in rank. This means that instructors always feel good about their knowledge as discovered by Archambault and Crippen (2009) from the study, which was conducted to examine the TPACK of 596 K-12 educators in the United States.

It was determined from the results of this study that instructors' perception of TK and TPK changed according to employment status whereas CK, PK, PCK, TCK and TPACK did not change according to employment status. It was concluded that part-time instructors perceived higher levels of TK and TPK when compared with fulltime instructors. This finding may be because of the fact that part-time instructors spend more time in developing themselves towards using technology and are able to create and adopt different teaching methods with the use of technology. They may be more enthusiastic about keeping updates on new technologies and their skills, both from individual and personal perspectives. Fulltime instructors should be motivated to keep up to date and use different technologies, since keeping updated and using different technologies can affect students' learning differently (Shin et al., 2009).

From the findings of this study, it was determined that instructors' perceptions of TK, TPK and TPACK changed according to department while CK, PK, PCK and TCK did not change according to department. Out of the five departments, the instructors from the CITE department have higher levels for TK, TPK and TPACK compared to the EE, ES, ELT and TLT departments. CITE department instructors teach and participate in learning with technology more than other departments. It is concluded that their level of technology integration and knowledge is higher both for professional and personal use.

Finally, the instructors' opinions of PCK change according to receiving in-service training oriented towards the use of technologies such as computers, smart boards, digital cameras, and videos, projectors, software programs and others. While there was no significant change in TK, CK, PK, TPK, TCK, and TPACK, there were positive effects on PK, TCK, TPK, and TPACK when considering the mean rank. In-service training oriented towards the use of technologies such as computers (22.6%), smart boards (46.1%), digital cameras and videos (7.5%), projectors (17%), software programs (11.3%) and others – included other technologies which are not listed (9.4%)

did not have significant effect on their PCK competencies. Kazu and Erten (2014) highlighted that the increase of teachers' knowledge of technology usage causes similar increase in their control, teaching process and their self-competence. This implies that if in-service training oriented towards the use of technologies has no increase on PCK or any of the knowledge areas then it is either that the training was not utilized effectively or was not enough. Therefore, appropriate attention should be given to in-service training in order to achieve a positive effect on the knowledge areas.

Considering the results in descending order listed as CK (M=6.5535), PK (M=6.4679), TPACK (M=5.9118), TCK (M=5.8000), TPK (M=5.8553), PCK (M=5.5660) and TK (M=5.5641) respective to their mean. Instructor possessed a high level of content, pedagogical, and technological knowledge although varying, through their understanding of better ways to interact with these knowledge (Jang and Tsai, 2012; Jang and Tsai, 2013; Ozgun-Koca et al., 2010). These better ways has evolved through the transformation of technology, pedagogy, and content (Kazu and Erten, 2014; Kereluik et al., 2010). This means that they are well oriented about the knowledge of the subject matter which they teach and how best this knowledge can be interacted with and transferred to the students, which can be as a result of the amount of time spent in service and some many other factors which were also examined. In general considering of TPACK, it was concluded that instructors have a high understanding of the interplay and relationship complexity between themselves, their students, the content, practices, and technologies. Kazu and Erten (2014) shared this same view. They possess the knowledge of strategies to combine technologies and teaching approaches, coordinate content used in teaching and ways to enhance students' learning in a technological enhanced learning environment. In addition, improving PCK and TK will help the instructors to use technology as a tool, which will be part of the whole process of teaching and not just as a tool to assist the teaching process.

Chapter 5

CONCLUSION

5.1 Conclusion

The intent of this thesis is to investigate instructors' perceptions (perceived knowledge) of TPACK from their experiences in the usage of technology in teaching within their various context (how instructors make intelligent pedagogy use of technology in instruction) and how it varies according to gender, age, period of service, ranking, employment status, department, and the state of in-service training oriented towards the use of technologies using the Mishra and Koehler (2006) framework within its seven constructs –TK, PK, CK, TCK, TPK, PCK, and TPACK. The literature review carried out for the purpose of this study and other research results, has demonstrated technological pedagogical content knowledge TPACK as a knowledge framework that is required for understanding of technology integration (Chai et al., 2010; Lin et al., 2012; Jang and Tsai, 2012; Jang and Tsai, 2013; Kazu and Erten, 2014; Koh and Chai, 2014; Koehler and Mishra, 2009; Mishra and Koehler, 2006; Schmidt et al., 2009; Shin et al., 2009).

Considering the first research question "What are the instructors' perceptions with regard to technological pedagogical content knowledge?", the research study concluded that the instructors had high level of perceived knowledge of TPACK. The study was able to help in understanding various ways instructors perceived TPACK.

This study reveals the differences that took place in the instructors' perception of TPACK in each knowledge dimension. Significant differences were reported for instructors' perceived knowledge of Technological Knowledge (TK) and Pedagogical Content Knowledge (PCK) dimension according to gender. Significant differences were reported for instructors' perceived knowledge of Technological Knowledge (TK) dimension according to age. Significant differences were reported for instructors' perceived knowledge of Technological Knowledge (TK) dimension according to period of service. Significant differences were reported for instructors' perceived knowledge of Technological Knowledge (TK), and Technological Pedagogical Knowledge (PCK) dimension according to employment status. Significant differences were reported for instructors' perceived knowledge of Technological Knowledge (TK), Technological Pedagogical Knowledge (TPK), and Technological Pedagogical Content Knowledge (TPACK) dimension according to department. Significant differences were reported for instructors' perceived knowledge of Pedagogical Content Knowledge (PCK) dimension according to in-service training. There was no change in any of the 7 TPACK dimensions according to ranking.

Considering the second research question "How do the perceptions of instructors in technological pedagogical content knowledge change according to gender, age, period of service, ranking, employment status, department, and the state of in-service training oriented towards the use of technologies?", the research concluded the following:

1. According to gender, male instructors perceived higher knowledge of TPACK than female instructors did with significant difference in TK and PCK.

2. According to age, instructors within 21-25 years age range perceived higher of TPACK knowledge than the others did. The younger instructors perceived higher TK.
3. According to period of service, instructors within 1-5 years' service range perceived higher knowledge of TPACK than the others did. The younger instructors perceived higher TK.
4. According to ranking, instructors perceived higher knowledge of TPACK irrespective of their ranking.
5. According to employment status, part-time instructors perceived higher knowledge of TPACK than fulltime instructors did with significant difference in TK and TPK.
6. According to department, instructors from the CITE department perceived higher knowledge of TPACK than instructors from other departments did with significant difference in TK, TPK and TPACK.
7. According to in-service training oriented towards the use of technologies, instructors whose response was negative were higher than the positive. Instructors who had who perceived higher PCK had more negative response than others did.

According to Elçi (2012), "Most of the educational faculty (83.3%) stated that they want to learn in order to facilitate students to solve problems and think critically" (p. 140). These significant differences were high, which shows that the instructors actually developed technological knowledge in connection with pedagogy in order to facilitate students learning.

5.2 Recommendations and Suggestions for Further Research

There has been rapid changes in learning, teaching processes and applications in the Faculty of Education, which is because of the increasing incorporation of technology in teaching. Amidst these developments, female instructors should be motivated and engaged in technological development in order to improve their TPACK. They should actively participate in the usage of creative methods such as the "learning by design", which when used together with the values TPACK framework offers, will move instructors towards a more transactional and co-dependent construction that indicates a sensitivity to the nuances of technology integration where technology, pedagogy, and content will no longer be as independent constructs (Koehler and Mishra, 2005). This will provide ways to integrate technologies effectively into applications in order to create flexible teacher development and strategies (Kazu and Erten, 2014).

Apart from educators training pre-service teachers on how to use technology for effective pedagogy, more attention should be directed to the training of fulltime instructors on how to integrate technological and pedagogical approaches, which will aid students in the better understanding of courses and educational practices.

More opportunities need to be made for the practice and implementation of the TPACK framework in other departments so as to bridge the technological gap that exists when compared with CITE department. Also, instructors' perceived knowledge of TPACK and competencies should be determined from time to time in order to motivate and encourage instructors towards developing technological pedagogical content knowledge –TPACK.

This research study has also determined significant implications which TPACK has on the professional development of instructors from their perceived knowledge, this makes it a proper framework that can aid the instructor to go beyond the traditional skilled way of teaching into a more techno-contextual way of teaching which appreciates the rich relationships between technology, content - the subject-matter and pedagogy the principles and methods. However, this can only be achieved if instructors adopt various ways as have been suggested by many other researchers such as the “learning by design approach” (Koehler and Mishra, 2005).

Following the conclusion of this study, the researcher recommends that more researches should be done to go beyond understanding instructors’ TPACK from perceived knowledge alone, but to consider observed attitudes that can help in understanding and determining actual TPACK competencies of instructors in Eastern Mediterranean University Faculty of Education.

Finally, further researches should adopt a qualitative approach or mixed approach in order to understand more deeply the results and reach more generalizable conclusions (Koehler & Mishra, 2005; Shin et al, 2009). The results of this research could be used to form a base for other research studies within Eastern Mediterranean University and other schools in North Cyprus.

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APPENDICES

Appendix A: (Instructors' Perceived Knowledge of TPACK Table)

Comprehensive Table on Instructors' Perceived Knowledge of TPACK

	Items	Mean	SD
	Technology Knowledge (TK)	**5.5641**	**1.05262**
TK1	I have the technical skills to use computers effectively	6.2453	.61724
TK2	I can learn technology easily	6.0189	.97054
TK3	I know how to solve my own technical problems when using technology	5.1509	1.59803
TK4	I keep up with important new technologies	5.5472	1.24909
TK5	I am able to create web pages	4.3654	2.09602
TK6	I am able to use social media (e.g. Blog, Wiki, Facebook)	6.0000	1.30089
	Content Knowledge (CK)	**6.5535**	**.69474**
CK1	I have sufficient knowledge about my teaching subject	6.6226	.65710
CK2	I have sufficient knowledge about my teaching subject like a subject matter expert	6.5472	.66697
CK3	I am able to develop deeper understanding about the content of my teaching subject	6.4906	.91194
	Pedagogical Knowledge (PK)	**6.4679**	**.55601**
PK1	I am able to stretch my students' thinking by creating challenging tasks for them	6.5660	.66533
PK2	I am able to guide my students to adopt appropriate learning strategies	6.3962	1.08024
PK3	I am able to help my students to monitor their own learning	6.4340	.69364
PK4	I am able to help my students to reflect on their learning strategies	6.3774	.65710
PK5	I am able to guide my students to discuss effectively during group work	6.5660	.60477

	Pedagogical Content Knowledge (PCK)	**5.5660**	**1.27532**
PCK1	Without using technology, I can address the common misconceptions my students have for my teaching subject	5.4906	1.39536
PCK2	Without using technology, I know how to select effective teaching approaches to guide student thinking and learning in my teaching subject	5.6792	1.47770
PCK3	Without using technology, I can help my students to understand the content knowledge of my teaching subject through various ways	5.5283	1.51408
	Technological Content Knowledge (TCK)	**5.8553**	**.93028**
TCK1	I can use the software that are created specifically for my teaching subject (e.g. e-dictionary/corpus for language; geometer sketchpad for maths; data loggers for science)	5.3396	1.73142
TCK2	I know about the technologies that I have to use for the research of content of teaching subject	6.1509	.81798
TCK3	I can use appropriate technologies (e.g. multimedia resources, simulation) to represent the content of my teaching subject	6.0755	.93745
	Technological Pedagogical Knowledge (TPK)	**5.8000**	**.97498**
TPK1	I am able to use technology to introduce my students to real world scenarios	5.7358	1.17916
TPK2	I am able to facilitate my students to use technology to find more information on their own	6.0566	.92850
TPK3	I am able to facilitate my students to use technology to plan and monitor their own learning	5.7925	1.00687
TPK4	I am able to facilitate my students to use technology to construct different forms of knowledge representation	5.7500	1.15258
TPK5	I am able to facilitate my students to collaborate with each other using technology	5.7358	1.21134

	Technological Pedagogical Content Knowledge (TPACK)	**5.9118**	**.83938**
TPACK1	I can teach lessons that appropriately combine social studies, technologies, and teaching approaches	5.9811	1.10053
TPACK2	I can select technologies to use in my classroom that enhance what I teach, how I teach, and what students learn	6.0566	.79458
TPACK3	I can use strategies that combine content, technologies, and teaching approaches that I learned about in my coursework in my classroom	6.0000	.88561
TPACK4	I can provide leadership in helping others to coordinate the use of content, technologies, and teaching approaches at my school and/or district	5.7308	1.15666

Appendix B: (Consent)

Consent Form for Participation in a Research Study

Title of Study:

Investigating Instructors' Perceived Knowledge of Technological Pedagogical Content Knowledge (TPACK)

Description of the research and your participation

You are invited to participate in a research study at Eastern Mediterranean University on TPACK conducted by Emeka Chukwuemeka Joshua. The purpose of this research is to investigate instructors' perceived knowledge of TPACK in using educational technology in teaching within their various context (how instructors make intelligent pedagogy uses of technology in instruction). I will like you to help me understand how you as an instructor choose to use technologies with your students in the classroom.

You will be asked to respond to questions related to your attitudes, experiences and reasoning about technology. I anticipated the survey to take between 35 to 50 minutes to complete.

Risks and Potential benefits

There are no known risks associated with this research. I anticipate that there is every possibility that your participation in this research will benefit you because it will help you to reflect on your personal experiences and also help in raising your awareness in some silent areas which development of knowledge may be required. I believe that the result of this study will aid the future design of professional learning opportunities for instructors and better digital tools for teaching in Eastern Mediterranean University. In all, I cannot guarantee that you will receive any benefit or compensation for your participation in this study.

Protection of confidentiality

The study is not a sensitive one but allows the participant to complete the survey anonymously. All individual information will be treated confidentially.

Voluntary participation

Your participation in this research study is voluntary. You may choose not to participate and you may withdraw your consent to participate at any time. You will not be penalized in any way should you decide not to participate or to withdraw from this study.

Consent

I have read this consent form and have been given the opportunity to ask questions. I give my consent to participate in this study.

Participant's signature_______________________________ Date: _|_______________

Appendix C: (Questionnaire)

Thank you for taking time to complete this questionnaire. Please answer each question to the best of your knowledge. Your thoughtfulness and candid responses will be greatly appreciated. Your individual name or identification number will not at any time be associated with your responses.

Demographic Information

1. **Gender**

   ☐Male ☐Female

2. **Age**

   ☐21–25 years ☐26–30 years ☐31–35 years ☐36–40 years ☐41–45 years ☐over 46 years

3. **Period of service**

   ☐1–5 years ☐6–10 years ☐11–15 years ☐16–20 years ☐21 years and above

4. **Ranking**

   ☐ Prof. Dr. ☐Assoc. Prof. Dr. ☐ Assist. Prof. Dr. ☐ Sen. Instructor ☐ Instructor ☐ Res. Asst.

5. **Employment Status**

   ☐ Fulltime ☐Part-time

6. **Department**

   ☐ Computer Education and Instructional Technologies ☐Elementary Education ☐English Language Teaching
   ☐ Secondary School Areas Education ☐Educational Sciences ☐ Fine Arts Education
   ☐Turkish Language Teaching

7. **Do you receive In-service training oriented towards the use of technologies such as**

   ☐ Computers ☐ Smart boards
   ☐ Projectors ☐ Software programs
   ☐ Digital cameras/videos ☐ Others ____________

Technology Knowledge (TK)	Strongly Disagreed	Disagree	Slightly Disagree	Neither A/D	Slightly Agree	Agree	Strongly Agree
1. I have the technical skills to use computers effectively							
2. I can learn technology easily							
3. I know how to solve my own technical problems when using technology							
4. I keep up with important new technologies							
5. I am able to create web pages							
6. I am able to use social media (e.g. Blog, Wiki, Facebook)							
Content Knowledge (CK)	**Strongly Disagreed**	**Disagree**	**Slightly Disagree**	**Neither A/D**	**Slightly Agree**	**Agree**	**Strongly Agree**
7. I have sufficient knowledge about my teaching subject							
8. I have sufficient knowledge about my teaching subject like a subject matter expert							
9. I am able to develop deeper understanding about the content of my teaching subject							
Pedagogical Knowledge (PK)	**Strongly Disagreed**	**Disagree**	**Slightly Disagree**	**Neither A/D**	**Slightly Agree**	**Agree**	**Strongly Agree**
10. I am able to stretch my students' thinking by creating challenging tasks for them							
11. I am able to guide my students to adopt appropriate learning strategies							
12. I am able to help my students to monitor their own learning							
13. I am able to help my students to reflect on their learning strategies							
14. I am able to guide my students to discuss effectively during group work							
Pedagogical Content Knowledge (PCK)	**Strongly Disagreed**	**Disagree**	**Slightly Disagree**	**Neither A/D**	**Slightly Agree**	**Agree**	**Strongly Agree**
15. Without using technology, I can address the common misconceptions my students have for my teaching subject							

16. Without using technology, I know how to select effective teaching approaches to guide student thinking and learning in my teaching subject							
17. Without using technology, I can help my students to understand the content knowledge of my teaching subject through various ways							
Technological Content Knowledge (TCK)	**Strongly Disagreed**	**Disagree**	**Slightly Disagree**	**Neither A/D**	**Slightly Agree**	**Agree**	**Strongly Agree**
18. I can use the software that are created specifically for my teaching subject (e.g. e-dictionary/corpus for language; geometer sketchpad for maths; data loggers for science)							
19. I know about the technologies that I have to use for the research of content of teaching subject							
20. I can use appropriate technologies (e.g. multimedia resources, simulation) to represent the content of my teaching subject							
Technological Pedagogical Knowledge (TPK)	**Strongly Disagreed**	**Disagree**	**Slightly Disagree**	**Neither A/D**	**Slightly Agree**	**Agree**	**Strongly Agree**
21. I am able to use technology to introduce my students to real world scenarios							
22. I am able to facilitate my students to use technology to find more information on their own							
23. I am able to facilitate my students to use technology to plan and monitor their own learning							
24. I am able to facilitate my students to use technology to construct different forms of knowledge representation							
25. I am able to facilitate my students to collaborate with each other using technology							

Technological Pedagogical Content Knowledge (TPACK)	**Strongly Disagreed**	**Disagree**	**Slightly Disagree**	**Neither A/D**	**Slightly Agree**	**Agree**	**Strongly Agree**
26. I can teach lessons that appropriately combine social studies, technologies, and teaching approaches							
27. I can select technologies to use in my classroom that enhance what I teach, how I teach, and what students learn							
28. I can use strategies that combine content, technologies, and teaching approaches that I learned about in my coursework in my classroom							
29. I can provide leadership in helping others to coordinate the use of content, technologies, and teaching approaches at my school and/or district							

Appendix D: (Faculty Research Authorization)

doğu akdeniz üniversitesi | eastern mediterranean university

İç Yazışma

Inter-Office Memorandum

Gönderilen/To :Prof. Dr. Halil İbrahim YALIN
Eğitim Fakültesi Dekanı

Tarih/Date : 15.05.2014

Gönderen/From :Doç. Dr. Ersun İŞÇİOĞLU
Bilgisayar ve Öğretim Teknolojileri
Eğitimi Bölüm Başkanı

Sayı/RefNo.: EGF05-2014/

Konu/Subject **:135403 numaralı Emeka Joshua Chukwemeka öğrencimiz hk.**

Bilgisayar ve Öğretim Teknolojileri Eğitimi Bölümü, Eğitimde Bilgi ve İletişim Teknolojileri Yüksek Lisans Programı öğrencimiz 135403 numaralı Emeka Joshua Chukwemeka tez çalışması kapsamında, Eğitim Fakültesi Öğretim Üyelerine anket uygulamak ve mülakat yapmak için izin talebinde bulunmuştur. Uygulayacağı anket, mülakat soruları ve izin talebi ekte mevcuttur.

Gereğini saygılarımla arz ederim.

Eİ/fg.