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"Investigating Pre-Service Teachers' TPACK through Teacher Training Program at Saudi Universities"

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Abstract:

The continuous advancement of technologies and their increasing integration into the education process places a great demand on teachers to be able to use such technologies effectively in their teaching and learning processes. In the Kingdom of Saudi Arabia (KSA), efforts to advance the education system, as articulated in the *Vision 2020* strategic plan, have pushed teacher training programs to better prepare teachers for the use of technology in the classroom. As a result, a number of one-year post-baccalaureate pre-service teacher preparation programs in the KSA have begun to incorporate more technology training in their programs. However, the degree to which these programs prepare pre-service teachers for the use of technology in their own teaching process remains largely unknown. To address this gap, the purpose of this study was to determine the extent to which teacher education programs in the colleges of education at three Saudi universities—Taif University (TU), King Khalid University (KKU), and King Faisal University (KFU)—prepare pre-service teachers to integrate technology into their classrooms. Koehler and Mishra's (2006) technological pedagogical content knowledge (TPACK) framework was followed, and a TPACK instrument adapted from Schmidt et al. (2009) was used to measure 529 pre-service teachers (135 males, 394 females) through self-reported TPACK scores at the beginning and at the end of their teacher preparation program.

The results showed a significant increase in the perceived knowledge level of pre-service teachers' TPACK model by the end of the training program in their Saudi university. The findings also showed that pre-service teachers' TK, CK, PK, PCK, TCK, TPK, and TPACK can be affected by gender in favor of males, even though most of the participants in the survey were female (74.5%). Finally, the findings reported that the higher the computer usage skills of participants in the teacher training program, the less knowledge they will likely gain from such programs, particularly in their TK and TPACK. These findings can help the KSA inform future improvements and developments in the teacher training programs that address technology skills in the classroom in the KSA.

Keywords: TPACK, teacher preparation, pre-service teachers, Saudi Arabia.

Introduction

Teachers are essential in the teaching–learning process, which may seem obvious, but it bears emphasizing. Without an academically qualified and professionally trained teachers, the educational system fails. Yet with the increasing application of increasingly complex information and communication technologies (ICTs) in education, the qualifications of teachers regarding technology are falling behind. Thus, there is an urgent need for teachers to keep abreast of technological advancements through training in order to keep pace with these changes and developments (Madbouli, 2007). Abdulaziz (2015) added that it is essential that the professional preparation of teachers meets the needs of the digital age and the changes this age has ushered regarding knowledge, the learner, and the learning environment.

The Kingdom of Saudi Arabia (KSA), like all other parts of the world, is striving to meet the educational needs within this technologically saturated world through teacher preparation programs. However, the effectiveness of teacher preparation programs in the KSA for preparing teachers to use technology is questionable. These programs have the same general objectives as determined by the Ministry of Education and are consistent with the KSA's strategic plan, called *Vision 2030* (KSA, 2017). According to the KSA's Ministry of Education (n.d.-b), one of the goals of *Vision 2030* is to develop a distinguished education system in order to build a globally competitive society in a knowledge-based economy. The vision is to provide the opportunity for education for all in an appropriate educational environment in the light of the educational policy of the KSA, which involves raising the quality of its outputs, increasing the effectiveness of scientific research, encouraging creativity and innovation, developing the community partnership, and upgrading the skills and abilities of the educational staff (KSA, 2017).

The objectives of *Vision 2030* include establishing criteria for teacher selection and training as well as developing and promoting educational competencies. *Vision 2030* also raises the level of expected education outcomes in order to meet the needs of society. One of the most important educational development methods mentioned in *Vision 2030* is improving the curriculum by implementing new educational objectives linked to teacher training programs and professional development (Ministry of Education, n.d.-b). Therefore, it is essential that teacher training programs seek to achieve the goal of *Vision 2030* by modifying the professional practices of the teacher to improve and develop the learner's education, as well as making changes recommended by the Ministry of Education.

In light of the rapid growth of technology, the lag in education, and the KSA's *Vision 2030* strategic plan, it is important to know whether Saudi teacher preparation programs effectively prepare pre-service teachers to integrate technology into their teaching in their classrooms. One way to address the effectiveness of Saudi preparation programs for the use of ICTs for educational purposes is to look at the issue from the perspective of technology knowledge within the TPACK framework, which stands for Technological Pedagogical Content Knowledge, which was developed by Koehler and Mishra (2005). Koehler and Mishra's TPACK is a model to conceptualize teachers' understanding of how technology knowledge interacts with content and their pedagogical knowledge in the educational process.

Problem Statement

Technology is changing the routines and practices in most fields, but education has fallen far behind the technological curve (Mishra & Koehler, 2006). Not only do many teachers underutilize technology but also traditional teacher preparation programs do not provide teachers with all the skills that they need to teach with technology (Alfayfi, 2013). These shortcomings are a concern given that innovations in technology and advancements in society depend on the ability, knowledge, and skills of teachers to teach *about* and *with* technology (Althaqafi, 2008). Unfortunately, programs for training teachers often do not incorporate enough training on ICTs (Jita, 2016) or do not provide appropriate ICT-training courses (Alev, 2009). Teacher training programs also typically lack introductory ICT courses that could help reduce teacher anxiety and increase their competency and confidence in using technology in their teaching (Anderson & Maninger, 2007). It is not surprising, therefore, that pre-service teachers often have difficulties in "understanding

pedagogical knowledge when they are involved in a technology integration course employing instructional design model" (Agustin & Liliasari, 2017, p. 2) and struggle to meet expectations of their students (Erdemır, Bakirci, & Eyduran, 2009).

A brief review of the literature revealed that much of the prior research on technology integration in the classroom is based on a theoretical framework called Technological Pedagogical Content Knowledge (TPCK or TPACK). The TPACK framework is an offshoot of Lee Shulman's pedagogical content knowledge (PCK) construct that has been modified to incorporate technology knowledge (Koehler & Mishra, 2009). The TPACK framework has been used by educational researchers as "a theoretical framework for understanding the teacher knowledge required for effective technology integration" (Jang, 2012, p. 91) as well as identifying the gaps in teachers' preparation for integrating technology in the classrooms (Srisawasdi, 2014).

Research on TPACK has been conducted around the world, including in Turkey (Can, Erokten, & Bahtiyar, 2017; Kartal & Afacan, 2017), Kuwait (Noha, Ali, & Fatimah, 2017), Thailand (Srisawasdi, 2014), and Indonesia (Agustin & Liliasari, 2017), among others. However, research on TPACK in the KSA is lacking. The research on TPACK in the KSA that does exist is limited to specific technologies (e.g., Sulaimani, Sarhandi, & Buledi, 2017) or only focuses on in-service teachers (e.g., Al Shehri, 2012), while general TPACK for pre-service teachers has gone largely unstudied. Based on a review of the literature, only two studies were found that focused on the TPACK of pre-service teachers in the KSA. One of them, by Alblaihed (2016), focused on science and mathematics and examined the relationship between the science and mathematics pre-service teachers' perceptions and practices related to the integration of technology in the classroom. The other study, by Al Turki (2015), focused on the TPACK theoretical framework and how it affected the knowledge and skills of the student-teachers in learning and delivering educational content. This study also investigated the benefits of TPACK for students and teachers, strategies for using the TPACK framework to integrate technology into the classroom, and obstacles experienced by pre-service student teachers when applying the TPACK framework in the classroom. No research has been found that has examined the extent to which graduates of any of the student teaching programs in the KSA are prepared to integrate technology into their teaching. Understanding whether pre-service teachers have the necessary TPACK knowledge to integrate technology into their teaching could help instructional designers to think about a course for pre-service teachers to meet their needs to integrate technology.

Purpose Statement

The purpose of this study is to determine the extent to which teacher education programs in the colleges of education at Saudi universities prepare pre-service teachers to integrate technology into their classrooms. This study focused on one-year post-baccalaureate training programs that are provided at three Saudi universities in the KSA: King Khalid University (KKU), Taif University (TU), and King Faisal University (KFU). More specifically, the researcher is interested in determining the extent to which the graduates of the teacher education programs are prepared to integrate technology into their teaching by comparing their TPACK scores based on an instrument adapted from Schmidt et al. (2009) at the beginning and at the end of the program, in the context of selected demographic variables. TPACK scores were divided into the following seven sub-scores: technological knowledge (TK), content knowledge (CK), pedagogical knowledge (PK), technological content knowledge (TCK), technological pedagogical knowledge (TPK), pedagogical content knowledge (PCK), and technological pedagogical content knowledge (TPACK).

Research Questions

To achieve the purpose of this study as outlined above, the following three research questions were addressed:

1. Is there a significant increase in the perceived knowledge level of pre-service teachers with regards to Koehler and Mishra's TPACK model by the end of the training program in their Saudi university?
2. Is there a significant difference between males and females in the perceived knowledge level of pre-service teachers by the end of the training program in their Saudi university?
3. Is there a significant difference in the perceived knowledge level of pre-service teachers depending on their computer usage skills level by the end of the training program in their Saudi university?

Significance

Theoretical significance. The TPACK framework provides a theoretical framework "for understanding the teacher knowledge required for effective technology integration" (Jang, 2012, p. 91). Understanding more about pre-service teachers' TPACK in the KSA can provide additional information about the usefulness of the TPACK framework from teachers' perspectives around the world. This study adds to previous research on TPACK that has occurred not only in the United States and Europe but also around the world, including Turkey, Kuwait, Thailand, and Indonesia among others.

Practical significance. Knowing pre-service teachers' TPACK can help instructional designers to think about the course they design for pre-service teachers in order to meet their needs to integrate technology. Also, knowing pre-service teachers' TPACK can help to develop a successful professional development program (PDP) that builds on the needs of pre-service teachers. Also, it can help prepare pre-service teachers to integrate technology in the classroom to meet 21st-century demands (Srisawasdi, 2014). Ultimately, the findings could help determine whether the one-year training program at Saudi universities prepares pre-service teachers to integrate technology into their teaching and improves their TPACK understanding.

Operational Definitions

The major terms related to the theory of TPACK need to be defined for this study. For clarity, researchers have defined terms as follows:

1. **Technical Pedagogical Content Knowledge (TPACK) Framework** is based on Shulman (1986) construct of pedagogical content knowledge (PCK) and defined to seven constructs of TPACK following Schmidt et al. (2009): technology knowledge (TK), content knowledge (CK), pedagogical knowledge (PK), pedagogical content knowledge (PCK), technological content knowledge (TCK), technological pedagogical knowledge (TPK), and technical pedagogical content knowledge (TPACK).
    a. ***Technology knowledge (TK)*** refers to the knowledge and understanding of information technology or various technology that teachers can apply to their lives, teaching and learning activity (Koehler, Mishra, & Cain, 2013). It also expresses knowledge that enables the teacher to accomplish and develop diverse

tasks by using technology.

b. ***Content knowledge (CK)*** is the knowledge of the subject matter, such as science content that science teachers need to learn and teach (Koehler et al., 2013). CK involves knowing how to organize content elements, how to shape and present concepts, the difficulty of concepts, and understanding knowledge of the learner.

c. ***Pedagogical knowledge (PK)*** is the knowledge of the learning and teaching processes. It includes the development and implementation of lesson plans, application of appropriate methods, and use of strategies for teaching, assessing, and classroom management. It also requires an understanding of the nature of learners (Koehler et al., 2013).

d. ***Pedagogical content knowledge (PCK)*** refers to the ability to deliver their knowledge to their students in a way that makes the content understandable to their students, based on Shulman's idea of the type of pedagogical knowledge that is appropriate to teach specific content (Koehler et al., 2013).

e. ***Technological content knowledge (TCK)*** encompasses the knowledge of how technology and content influence each another. It requires a deep understanding of how how certain technologies impact how the content itself is learned (Koehler et al., 2013).

f. ***Technological pedagogical knowledge (TPK)*** is an understanding of how learning processes and teaching can change when using certain technologies in certain ways, and how technologies can create affordances and constraints for teaching (Koehler et al., 2013).

g. ***Technological pedagogical content knowledge (TPACK)*** in this case refers to not to the theoretical framework in general but to the type of knowledge in particular. TPACK is an understanding of how learning processes and teaching can change when using certain technologies in certain ways, which is created from interactions among content, pedagogy, and technology knowledge, but is "different from knowledge of all three concepts individually" (Koehler et al., 2013, p. 66).

2. **Teacher preparation.** Teacher preparation refers to undergraduate college preparation of all preservice teachers. In this study, teacher preparation leads to a degree in education or on content and is a prerequisite for teacher candidate that lead to a degree or licensure in Saudi Educational Institutions.

3. **Teacher training program.** According to Altwaijri and Almuhaimeed (2017), teacher training is defined as a set of academic and educational programs that are built to graduate a generation of teachers who are proficient in their subject and their teaching skills. The teacher education program can be offered in two systems: Integrated system and sequential system. Abuhamid (2015) defines it as institutions that prepare the student culturally, scientifically and educationally prior to service. The teacher preparation program in this study refers to one-year post-baccalaureate programs offered in a sequential system in which the student is enrolled after they finish their university coursework, in which they study for one or two years in one of the educational institutions.

Delimitations and Limitations

Delimitations. This study is delimited to examining to the pre-service teachers who already graduate from one of the teacher preparation programs at any educational institutions in the KSA. At the time of the study, the teacher preparation programs were temporary closed for improvement, which did not allow for data collection of students currently enrolled in the program, and the research could not wait for the programs to re-open due to time constraints set by the researcher's scholarship terms. To address the research questions within the constraints of the study, the study answered the research question by trying to find out the TPACK preparation of pre-service teachers who already finished their teacher preparation programs in Saudi universities but before they began teaching. Thus, this study did not include the pre-service teachers who either did not finish their teacher preparation programs or were already in service at the time of the study.

Another delimitation was that the researcher collected the data only from the pre-service teachers who already finished their teacher training program to measure the perceived growth of their knowledge at the beginning and the end of their teacher training program. So, the researcher asked pre-service teachers to complete the survey by thinking back about their knowledge when they started this program and after they finish their program (where they were when they started this program and where they are now).

Limitations. The findings of this study are limited to pre-service teachers in general for all subjects at Saudi Universities in KSA. All the pre-service teachers in KSA are part of one education system, which is the Ministry of Education. So, the researcher did not have any information about specific subjects or places other than pre-service teachers in the teacher preparation programs at Saudi universities.

Literature Review

Technological Pedagogical Content Knowledge (TPACK)

Theoretical background. The TPACK framework is based on Shulman's (1986) construct of pedagogical content knowledge (PCK). Shulman noted that the successful practice of teaching is related to the teachers' use of pedagogical methods that fit the content and their students' level of understanding. This means mixing knowledge of content and knowledge of pedagogy with the teacher's experience to teach subjects. Although Shulman considered technology to be instrumental in supporting effective teaching in different contexts, he did not include it as part of his original PCK framework.

As technologies developed, it became difficult to ignore the role of technology in education as more than a facilitator of teaching. In response to the growing integration of technology in the practice of teaching, Mishra and Koehler (2006) modified the PCK model to incorporate technology knowledge as one of the main competencies of teachers and proposed a variation they called technological pedagogical content knowledge (TPACK). Since Mishra and Koehler (2006) first proposed the TPACK model, research on the topic has steadily grown. According to Koehler et al. (2013), "The development of TPACK by teachers is critical to effective teaching with technology" (p. 60).

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There are three main elements of teachers' TPACK: content knowledge (CK), pedagogical knowledge (PK), and technological knowledge (TK). In addition to considering each element separately, the TPACK framework also models the interactions between and among these three elements of knowledge, which, in addition to the previously mentioned PCK and TPACK, also includes technological content knowledge (TCK) and technological pedagogical knowledge (TPK). The relationship between these elements overlap in some ways but are distinct in other ways. This relationship is illustrated in Figure 1. To better understand each element of the TPACK model in their separate and overallping parts, it is necessary to define and review the literature them one by one.

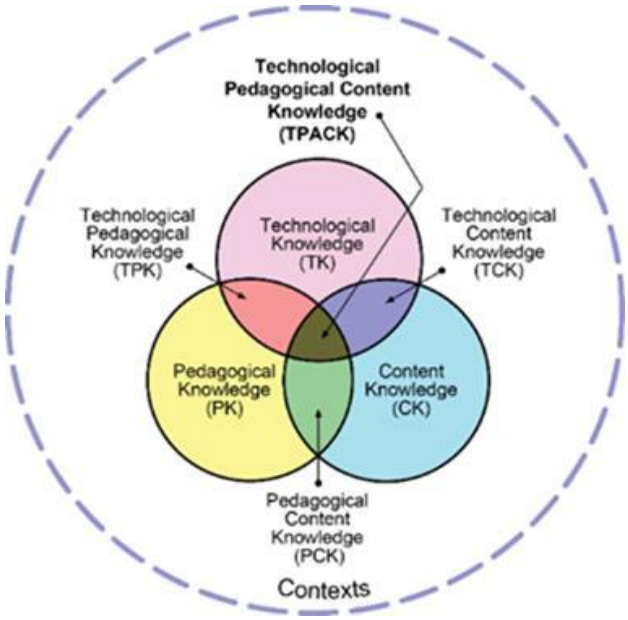

Figure 1. The TPACK framework. Adapted from "What is technological pedagogical content knowledge?". by Koehler, M. J., & Mishra, P, 2009, Contemporary Issues in Technology and Teacher Education, 9(1), p. 63. Copyright 2009 by the Society for Information Technology & Teacher Education.

TK refers to the knowledge and understanding of the various information and communication technologies (ICTs) that teachers can apply to their teaching and learning activity (Koehler et al., 2013). It also describes knowledge that enables the teacher to accomplish and develop diverse tasks by using technology. According to Koehler and Mishra (2009), TK also requires that teachers keep abreast of the ever-changing nature of technology due to its rapid evolution. Teachers must be aware of these developments and can learn and adapt to them. Teachers must also be prepared to provide their students with educational opportunities to support technology. All of this requires learning ICT skills and digital competencies (McKnight et al., 2016), or what Koehler and Mishra call TK. To improve TK, Mohamed (2018) emphasized the necessity of training teachers in the use of technological innovations and the importance of using technological innovations in the classroom environment.

CK is a teacher's knowledge about the subject matter, such as the science content that science teachers need to learn and teach (Koehler et al., 2013). For example, knowing how to organize content elements for better teaching, how to shape and present concepts, knowing the difficult or easy concepts to learn, and understanding the tribal knowledge of the learner, understanding the basics of knowledge in a more profound way to the content of the courses he teaches.

PK is a teacher's deep knowledge about the learning and teaching processes, method, strategies and practices (Koehler et al., 2013). Such as, the development and implementation of lesson plans, methods, and strategies used in teaching, strategies for assessing learner understanding, classroom management, and the nature of learners. The pedagogical knowledge of the teacher helps to understand how learners build knowledge, acquire skills, and develop positive habits of mind and behavior towards learning. Pedagogic knowledge also requires the understanding of cognitive and social theories, and advanced learning theories and how they are applied in the design of educational situations.

PCK is a teacher's ability to deliver their knowledge to their students in a way that makes the content understandable to their students, based on Shulman's idea of the type of pedagogical knowledge that is appropriate to teach specific content (Koehler et al., 2013).

TCK is a teacher's ability to not only know how to use various ICTs but also how to use appropriate ITCs for a specific type of content and how a particular technology can play an important role in delivering content in a successful and effective way (Koehler et al., 2013). Too often, teachers simply add a new, trendy technology in the classroom in a somewhat superficial way when it may not improve instruction, or worse, may impede learning or distract from the content. In contrast, TCK is the synthesis of technology and content to effectively teach a lesson.

TPK is a teacher's understanding of how learning processes and teaching can change when using certain technologies in certain ways (Koehler et al., 2013). McKnight et al. (2016) noted that learning pedagogies in the 21st century have emerged to meet the demands of a contemporary learner who increasingly relies on social networking technologies. Therefore, pedagogy must be compatible with modern trends and technologies.

TPACK is the type of knowledge where all the above knowledges overlap. To possess a strong TPACK, a teacher should understand how a particular concept is formulated and presented through the use of technology, whether the use of the technology is appropriate for the content, and whether the use of the technology is pedagogically sound (Koehler et al., 2013). TPACK is created from interactions among content, pedagogy, and technology knowledge, but is "different from knowledge of all three concepts individually" (Koehler et al., 2013, p. 66).

Koehler and Mishra (2009) have asserted that developing knowledge about the content, technology, and pedagogy of teachers—i.e., TPACK—is critical for effective teaching using technology. Dalal, Archambault, and Shelton (2017) have agreed that teachers' knowledge of content, technology, and pedagogy is essential for the successful integration of technology into education. Voogt and McKenney (2017) found that when clarifying the relationships between content, technology, and pedagogy, teachers were more willing to learn and use technology in their classrooms.

Importance of TPACK. Based on the findings of previous studies (Can et al., 2017; Herring, Koehler, & Mishra, 2016; Jang, 2012), the TPACK framework has proven helpful to educational researchers and practitioners seeking to understand the type of teacher knowledge that is required for effective technology integration. In sum, the previous studies (Can et al., 2017; Herring, Koehler, & Mishra, 2016; Jang, 2012) found that the TPACK model is important because it can:

1. Transform theoretical ideas related to technology and education to practical applications that serve the specialty.
2. Support the concepts of sustainable professional development for teachers and the need to follow up everything in technology, education and content to develop professional performance.
3. Improve educational practices for teachers in different disciplines.

4. Inform teachers' choices about the best ways to facilitate teaching subjects.
5. Improve the self-efficacy of teachers.
6. Help teachers solve technical problems and manage classrooms.
7. Guide the development of the technological competence of teachers and improving their skills in using modern technological applications.

Pre-Service Teachers' TPACK

Emerging technology has heavily impacted traditional education methods. Different forms of technological tools are used today in education, such as SMART Boards, Computers, iPads, Web 2.0, software programs, learning hardware, applications, collaboration tools, educational CDs, the Internet, etc. These education technology tools can enhance and support the communication among learners and teachers (Wachira & Keengwe, 2011). As a result of the growth of technology, the need for technologically qualified teachers has emerged as a main component of a successful educational experience. Moreover, teachers must also "have broader capabilities than content knowledge and the ability to use pedagogy in the classroom" (Smaldino, Lowther, Mims, & Russell, 2015, p. 219).

How to use emerging technologies effectively in teaching has presented numerous challenges for educators to add to the already difficult task of deciding strategies and technologies appropriate in a specific subject. Angeli and Valanides (2014) stated that pre-service teachers' preparation programs must first and foremost establish the knowledge necessary for "entry-level teaching" (p. 28). That requires preparing pre-service teachers to enter the teaching field with a basic but robust foundation in courses related to technology, content, methods, and practicum/internship experiences.

In order for teachers to use the technology students have to its fullest educational potential, they need to be able to seamlessly integrate technology into the educational process based on the use of all four TPACK components together. While educational technology is an integrated process involving educational ideas, theories, and applications in learning and teaching. The needs of technological, pedagogical, and content knowledge has emerged to develop more appropriate and redesigned learning paths for teachers preparation program to teach with technologies (Angeli & Valanides, 2014). The greater use of technology by teachers, has increased the level of self-confidence for the use of technology to enhance teaching and learning (Fathallah, 2004). Therefore, teacher preparation programs greatly affect pre-service teacher knowledge and attitudes, and hence their confidence and readiness to use information and communication technologies (ICTs) in the classroom (Agustin & Liliasari, 2017; Can et al., 2017; Durdu & Dag, 2017).

Can et al. (2017) conducted a cross-sectional study that explored the TPACK level among 269 pre-service teachers. The results showed that as the grade level of pre-service teacher increases, their TPACK level increases as well. Moreover, there is a significant difference in all dimensions for pre-service teachers' TPACK scale at the 1st grade. Also, demographic variables (gender, owning computer, computer usage level and grade level) can affect TPACK, so pre-service teachers' experiences with technology in teaching have a positive impact on TPACK (Can et al., 2017).

A meta-synthesis by Yilmaz (2015) examined 59 studies include 37 papers, 15 dissertations, and 7 assertions that were published between the years of 2008-2014 about TPACK studies in Turkey. The study found no meaningful relationship between gender and TPACK in Turkey. However, although Turkey is a predominately Muslim Middle Easter country, these findings cannot be generalized to the education system in the KSA because, unlike in Turkey, the Saudi school system, including teacher preparation programs, segregate males and females.

While research that addresses pre-service teachers' TPACK in other countries is fairly common, research on TPACK in the KSA is rare; the only studies identified in this literature review about teachers' TPACK in the KSA are Bingimlas (2018) and Alhababi (2017). However, several research studies have been conducted in other Arab countries, such as Egypt (Fouda, 2017; Mohamed, 2018) and Kuwait (Noha et al., 2017). A quantitative research study by Bingimlas (2018) analyzed 243 in-service teachers (111 males, 132 females) from the Kharj District of the KSA to understand their level of TPACK in technology, pedagogy, and content using a self-administered survey based on Mishra and Koehler (2006). Of the 243 in-service teachers, 116 were primary teachers, 55 middle school, and 72 secondary, all with a range of years of teaching experience. The results of their study showed most in-service teachers had a medium level of confidence in the TPACK framework. Also, there are differences between them based on gender, teaching subjects, and teaching experience. There is also a significant difference between technological content knowledge and teaching experience. The researcher also recommended that in-service teachers should change their teaching methods from traditional learning methods to active learning methods by using technology. Also, the Ministry of Education should focus on providing both girls 'and boys' schools with educational technologies and training them to use these technologies effectively.

The other Saudi study, conducted by Alhababi (2017), used mixed methods to explore the teaching effectiveness of 56 male English teachers in public schools and student achievement when teachers integrate technology into technology-rich, English language learning classrooms in the KSA using the TPACK framework. The results of this study showed that the TPACK framework was a useful tool to enhance teaching and learning when implemented and used well. The results also showed that after the workshop, teachers have better understand how they could use English for digital educational purposes. Also, their confidence and perception significantly increased in teaching in an English digital classroom after the workshop. Additionally, all seven components of TPACK were statistically significant at least at the 95% confidence level after the workshop. The research discusses that increase happened because teachers had given the right training in their workshop that enabled them to use technology in the right way to deliver high expectations for the understanding of the language. Furthermore, the results of this study revealed that teachers' TPACK had a strong positive correlation with the students' positive achievements. The results also showed that teachers largely supported the use of digital technology in the classroom and encouraged students to use technology for their educational purposes. However, teachers pointed out that educational institutes in the KSA are not fully qualified or equipped for mobile learning, so there was more time required to ensure that both teachers and students rely on digital technologies for their lessons and knowledge transfer. The researcher recommended increased training to allow teachers to integrate technology in meaningful ways at the classroom level.

Teacher Preparation Programs in the KSA

The education system of any country is the mainstay for the success and progress of the society; however, the education system cannot thrive without qualified teachers to implement the policies of this system. Thus, it is of the utmost importance to prepare the teacher and the extent of its impact in achieving the objectives of the desired education. In the KSA, one of the most critical problems in the education system is the weakness of teacher preparation and qualification, as many lack modern skills in the processes of teaching and learning, as stated in the report of The Ministry of Education

(2012). Hence, the KSA, like other countries, was required to develop the system of preparing its teachers in a manner consistent with these constantly changing challenges, which contributes to the improvement of the outputs of the educational system (Binhwaimel & Alanadi, 2015).

A comparative study conducted by Al-Hazza (2018) looked into developing teacher preparation in the KSA. One of the most prominent findings is that the acceptance rates in the teacher training institutions in the KSA are high because of the weak acceptance criteria, which affects the quality of their outputs. In addition to the weakness of the concentration of teacher preparation programs in the KSA is to provide the student with the teacher research skill. One of the most prominent recommendations was to intensify the period of practical training in teacher preparation institutions in the KSA. This is because several skills are acquired only by prolonged practice. Also, the study recommended to attract graduates of the master's degree in the profession of education and provide incentives for it, to be adequately prepared, both in terms of research and in terms of different skills required in the teacher.

Some studies have recommended the need to develop teaching strategies and assessment methods used in the preparation of Arabic language teachers in the KSA in light of the international standards for building teacher preparation and planning programs (Al-Aqili, 2011). Another study stressed the need to conduct more educational research on teacher preparation and employment in the KSA (Sirafi, 2006).

Teacher preparation institutions in the KSA. Students who wish to work in the teaching profession are enrolled in the educational colleges affiliated with the universities after obtaining a high school certificate. Non-educational university graduates can enroll in teachers' preparation programs (as a diploma or Master) that follow universities to become qualified to work in the field of education. The duration of study in these programs ranges from one to two years. The number of public universities in the KSA as indicated by Ministry of Education (n.d.-a) is 29, and they are studied for at least four years.

Teacher preparation systems in the KSA. There are two Teacher preparation systems in the KSA: the sequential system and the integrated system. In the sequential system, students are enrolled after the university and study for one to two years in one of the colleges of education to earn educational diploma or a professional master's degree. In the integrated system, the student studies educational and specialized courses at the same time over four years (Abuhamid, 2015). Thus, the teacher preparation system in the KSA provides options for those who wish to work in the teaching profession, to ensure the preparation of qualified educational staff to carry out duties and work.

Student admission system in the KSA. Admission to the teacher training institutions in the KSA is subject to several conditions, the most important of which is obtaining a high school certificate for integrated system or a bachelor's degree for sequential system, good conduct, and being medically fit. Some universities are also working to take a certain percentage of the result of high school or bachelor, in addition to a certain percentage of the tests of abilities and achievement, organized by the National Center for Assessment (Qiyas) (Al-Hazza, 2018).

Teacher preparation in the KSA. Teacher preparation in the KSA includes three aspects: scientific (academic), professional (educational), and cultural (general) preparation. The scientific (academic) consists of an in-depth study of one or more majors in the scientific fields that teachers will teach. The depth of teachers in their specialization requires them to keep in touch with the continuous developments in the area of specialization. The assessment systems for student consists of written tests, research, presentations, and other related courses, as determined by the faculty member, in addition to the written examinations that the student undergoes at the end of each semester for all classes (Al-Hazza, 2018).

Practical education. Practical education is training the pre-service teacher receives in the KSA before joining the teaching profession to become teachers (Abuhamid, 2015). The college of education offers that and often in the last academic year, or when the pre-service teacher enrolls in the educational diploma in some public or private universities or educational studies institutes for bachelor holders who wish to become teachers (Al-Hazza, 2018).

Updates to the KSA teacher preparation programs. In pursuit of development and modernization in the educational system of the KSA, the Minister of Education issued a decision in the year 2017/2018 to suspend all education programs preparing the teacher in all universities in the KSA in order to develop and modernize them. These temporary closings included the teacher preparation programs that are the subject of this dissertation, which are King Khalid University (KKU), Taif University (TU), and King Faisal University (KFU). During this period of development, TU took this opportunity to update the educational diploma program for teacher preparation through a partnership with the United Nations Educational, Scientific Cultural Organization (UNESCO) Regional Center of Quality and Excellence in Education (RCQE) (“RCQE Signs,” 2016). Through guidance from the UNESCO RCQE, the TU teacher preparation program was built according to international standards. Therefore, the teacher preparation program at TU is the most recently updated among the KSA universities.

Similarities and differences between the teacher preparation programs. The three teacher preparation programs (KKU, TU, and KFU) have the similar teacher preparation program systems, student admission system, and practical education as mention above. One difference between the teacher preparation programs in the KSA is the duration of the teacher preparation programs. The teacher preparation program at TU differs from the program teacher preparation programs at KKU and KFU in the duration of the study, which is three semesters, the theoretical study is in two semesters, and the third semester is devoted to practical training. This is different from all previous sequential teacher preparation programs, such as KKU and KFU, which is two semesters as illustrated in Table 2 and 3. The theoretical study was taken in first and second semester while the practical training was taken during the second semester with the theoretical study.

Another difference between the programs is the type of courses of the teacher preparation programs. For example, the Educational Research Skills, Introduction to Special Needs Education, and Professional Development Seminar 1 and 2 courses are taught in the TU teacher preparation program but not at KKU or KFU. The latest teacher preparation program developed at TU is also distinguished from the teacher preparation program at KKU and KFU because it focuses more on student-centered learning and direct educational experiences, as well as developing student research skills. Moreover, TU’s

design is in line with the academic accreditation standards and according to various international, regional, and local reference indicators (CITE).

In general, all teacher preparation programs aim to prepare educationally qualified teachers, including male and female teachers, by providing them with the necessary educational and teaching skills. However, TU is distinguished by its focus on also providing pre-service teachers with methods of dealing with students with special needs. Also, it is focusing on the self-development of the pre-service teachers by providing them with educational research skills and implementing procedural research.

Although they differ in notable ways, the teacher preparation programs share some similarities in course offerings as well. One similar program across programs is the Teacher Practicum, which focuses on observations before practicing practical training in the last semester and differs only in the number of credit hours. Another common program is Educational Psychology, which only differs in the number of courses offered. Educational Technology is also a common course, but it differs in the number of courses and credits. Additionally, all three universities offer an Educational Measurement and Evaluation course, which only differs in the numbers of courses. Finally, Curriculum and Instruction is common across all three programs, differing only in the numbers of courses offered.

Methodology

Design:

Based on the traditional classification of non-experimental research, this study followed a correlational design. According to Creswell (2011), these designs are used when the purpose is "to explain the association among variables" (p. 430). Using this design allowed the researcher to examine the relationship between the level of pre-service teachers' TPACK at the beginning and at the end of the program and selected demographic variables (i.e., gender and computer usage skills level) in the student teaching program.

Sample and Population:

The population of interest in this study is male and female pre-service teachers in the teacher preparation programs at Saudi public universities. In this study, the researcher concentrated on the pre-service teachers who graduated in 2018-2019 from one of the following three universities: KKU, TU, and KFU. The estimated population size for the present study is approximately 1886 pre-service teachers, all of whom have earned a bachelor's degree in any subject matter and have entered this program to acquire a license to teach. The sample size of approximately 317 pre-service teachers were sufficient at 95% confidence margin and 5% error according to Krejcie and Morgan (1970) table.

Variables and Instrumentation:

In this study, there were six variables. The dependent variable is pre-service teacher's perceived knowledge. This is a latent variable (construct) that was constructed by applying the Rasch model to the 29 items from a survey adapted

from Schmidt et al. (2009) to assess pre-service teacher knowledge across a variety of content areas. The items for the pre-service teacher's perceived knowledge were divided into seven scales for each of the following times of TPACK knowledge:

1. Technology knowledge (TK) scale (7 items)
2. Pedagogical knowledge (PK) scale (7 items)
3. Content knowledge (CK) scale (3 items)
4. Technology content knowledge (TCK) scale (1 items)
5. Technological Pedagogical Knowledge (TPK) scale (5 items)
6. Pedagogical content knowledge (PCK) scale (1 item)
7. Technological pedagogical and content knowledge (TPACK) scale (5 items).

The dependent variable was measured on an equal interval measurement scale using a 4-point Likert scale of agreement (from 1-strongly disagree to 4-strongly agree). The survey adapted from Schmidt et al. (2009) also contained demographic questions to capture the independent variables (i.e., gender, computer usage skills level, teacher preparation program and grade level), which were added by the researcher. The grade level refers to the program (before the start of the program and the end of the program). Owning a computer was measured as yes/no. The computer usage skills level was defined as the ability (beginner, moderate, and professional) to use computers and related technology. The teacher preparation program refers to the affiliated institution that has a teacher preparation program at Saudi Universities (KKU, TU, and KFU).

Procedures

To collect the data on pre-service teacher knowledge and demographics, an online survey was administered electronically via Qualtrics and sent to potential participants via email. Surveys are efficient data collection tools that allow for collecting data from many participants in a short period of time. Also, the online survey was taken on the participants own personnel device at a time and place of their choosing, which gave privacy to participants by choosing when and where to complete the survey.

Data collection took place in the spring of 2020 on pre-service teachers who already finished their teacher preparation programs at the Saudi universities included in this study (KKU, TU, and KFU). The researcher collected the data at one time from the pre-service teachers who already finished their teacher training program. Therefore, the survey measured their perception of the growth of their knowledge at the beginning and the end of their teacher training program. Their perspectives were gathered by asking pre-service teachers to complete the survey, which involved thinking back about their knowledge when they started this program and now after they finished their program (i.e., where they were when they started this program and where they are now).

A link to the survey was emailed to the participants electronically during the Spring 2020 semester via their affiliated institution. The link was available for one month to provide plenty of time for pre-service teachers to participate to reach the target sample size. At the end of each week, the researcher sent reminders to participants by their affiliated Institution to complete the survey. So, the researcher did not have the personal contact information for the participants because the researcher contacted the participants through their affiliated institution.

Research Ethics and Permissions

Prior to collecting any data, the researcher needed to get the IRB approval from the University of Toledo. The researcher also needed to obtain an informed consent from the participants before collecting the data. All participants were asked to read and sign informed consent form electronically as a part of the survey that were emailed to the participants electronically. The informed consent form explained information about the scope and the purpose of the study, the possible benefits and the risks of the participants, and the confidentiality assurances.

Data Analysis

The research used the Statistical Package for the Social Sciences (SPSS, IBM, Version 25.0) program to analyze the answer of the research questions. All of the t-tests and ANOVAs described below have the assumption of a normal distribution. In order to check if these variables meet the assumption of normality, a Kolmogorov-Smirnov analysis and a Kruskal-Walis test of normality were ran, and the histogram of each distribution within each group was examined and compared to see that it appears to be a roughly normal distribution. Once normality was confirmed, each of the three research questions were addressed using the data analysis methods described in the following three sections.

Research question one. To answer the first research question, five paired samples t-tests in pre-service teachers' TK, PK, CK, TPK, and TPACK and two Wilcoxan Sign-Rank tests in pre-service teachers' PCK and TCK were run. In order to determine how each teachers' training programs resulted in a change in pre-service teachers' self-reported TPACK and how the scores of pre-service teachers' TK, PK, CK, TCK, TPK, PCK, and TPACK differed due to their grade level (before the start of the program and the end of the program).

Research question two. To answer the second research question, seven two-way ANOVA tests were used. In order to understand the interactions between the scores of pre-service teachers' TK, PK, CK, TCK, TPK, PCK, and TPACK differed in their teacher training programs due to their gender and teacher training programs.

Research question three. To answer the third research question, seven two-way ANOVA tests were used. This test was chosen to understand the interactions between the scores of pre-service teachers' TK, PK, CK, TCK, TPK, PCK, and TPACK differed in their teacher training programs due to their computer usage skills level and teacher training programs.

Results

This study examined Saudi pre-service teachers' technological pedagogical content knowledge (TPACK) in their training program in Saudi universities. It also examined the impact of their training program on their TPACK knowledge level (TK, CK, PK TCK, TPK, PCK, and TPACK) with respect to the following independent variables: gender, computer usage skills level, and their teacher preparation program. In this chapter, the researcher presents the research findings for each of the research questions by using the latest version of the SPSS program to analyze the answer each of the research questions. First, an overview of participant characteristics is provided. Next, results of paired samples t-tests and the

Wilcoxan Sign-Rank tests are presented to answer research question one. Finally, results of two-way ANOVA tests are presented to answer research questions two and three.

Participant Characteristics

A total of 740 surveys were emailed to pre-service teachers in spring 2020, of which 529 were completed, for a response rate of 75%. The most of respondents attended TU (43.1%) followed by KKU (38.8%), while only 18.1% attended KFU. Moreover, most of the respondents were female (74.5%). Lastly, most rated their level of computer skills as moderate (60.1%).

The Results of the Research Question One

The paired samples t-test shows a significant difference in the independent variables before and after the training program ($p < 0.05$). In order to determine whom those differences favored and whether there was an increase or decrease, the total mean scores taken from descriptive statistics of Subscales of TPACK Scale were compared to the mean grade level (before and after the program) for each paired samples t-tests. Those results show that the pre-service teachers' PK resulted in the highest score both before and after they finish their program with mean score (20.28 and 23.24). Also, there was a significant increase in the perceived knowledge level of pre-service teachers with regards to their TK, CK, PK, TPK and TPACK by the end of the training program in their Saudi university.

Moreover, there was a significant difference in pre-service teachers' PCK and TCK scores based on negative ranks when compared their scores according to their grade level (before and after the program the program) ($p < 0.05$). The perceived knowledge level of pre-service teachers with regards to their PCK and TCK showed a significant increase by the end of the training program.

In summary, for research question one, five paired samples t-tests and two Wilcoxan Sign-Rank tests were used. The paired samples t-tests and the Wilcoxan Sign-Rank tests show that there was a significant increase in the perceived knowledge level of pre-service teachers with regards to their grade level (before the start of the program and the end of the program) of the training program in their Saudi university.

The Results of the Research Question Two

For the research question two, 7 two-way ANOVA tests were used to compare the following dependent and independent variables:

- DVs = TK, CK, PK, PCK, TCK, TPK, and TPACK.
- IVs = gender (male, and female) and teacher training programs (KFU, KKU and TU).

The ANOVA shows that there was a significant difference for the gender factor in all of the pre-service teachers' knowledge as follows:

- TK ($F (1, 523) = 17.741$, $p = .000$) in favor of male group

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- CK (F (1, 523) = 7.465, p = .007) in favor of male group
- PK (F (1, 523) = 18.664, p = .000) in favor of male group
- PCK (F (1, 523) = 12.349, p = .000) in favor of male group
- TCK (1, 523) = 10.331, p = .001) in favor of male group
- TPK (F (1, 523) = 18.994, p = .000) in favor of male group
- TPACK (F (1, 523) = 17.024 p = .000) in favor of male group

Additionally, there was a significant difference for the institution factor in the most of pre-service teachers' knowledge except pre-service teachers' PCK and TPK as follows:

- TK (F (2, 523) = 6.148, p = .002) in favor of KKU (EM = 3.207).
- CK (F (2, 523) = 4.350, p = .013) in favor of KKU (EM = 1.473).
- PK (F (2, 523) = 3.037, p = .049) in favor of KKU (EM = 4.336
- TCK (F (2, 523) = 5.558, p = .004) in favor of KKU (EM = 0.662).
- TPACK (F (2, 523) = 17.024, p = .004) in favor of KKU (EM = 3.269).

Also, there was a significant difference for the interaction between the gender and institution factors in pre-service teachers' knowledge as follows:

- TK (2, 523) = 3.065 p = .047)
- CK (F (2, 523) = 4.659p = .010)
- TCK (2, 523) = 5.740 p = .003)

Lastly, there was a visible difference in pre-service teachers' TK, CK, PK, TCK and TPACK between male and female groups at KKU and this difference was in favor of male group.

The Results of the Research Question Three

For research question 3, seven two-way ANOVA tests were used.

- DVs = TK, CK, PK, PCK, TCK, TPK, and TPACK.
- IVs = computer usage skills level (Beginner, Moderate and Professional) and teacher training programs (KFU, KKU and TU).

The ANOVA shows that there was a significant difference for the computer usage skills level factor in the most of pre-service teachers' knowledge except pre-service teachers' PK as following:

- TK (F (2, 520) = 16.520, p = .000) in favor of these pre-service teachers in the Beginner level (EM = 4.465).
- CK (F (2, 520) = 3.512, p = .031) in favor of these pre-service teachers in the Beginner level (EM = 1.422).
- PCK (F (2, 520) = 3.310, p = .037) in favor of these pre-service teachers in the Moderate level (EM = 0.401).
- TCK (F (2, 520) = 3.186, p = .042) in favor of these pre-service teachers in the Beginner level (EM = 0.575).
- TPK (F (2, 520) = 3.525, p = .030) in favor of these pre-service teachers in the Beginner level (EM = 2.940).

- TPACK (F (2, 520) = 8.564, p = .000) in favor of these pre-service teachers in the Beginner level (EM = 3.748).

Also, there was a significant difference for the institution factor in the following knowledge of pre-service teachers except pre-service teachers' PCK and TCK:

- TK (F (2, 520) = 3.501, p = .031) in favor of these pre-service teachers at KKU (EM = 2.940).
- CK (F (2, 520) = 4.129, p = .017) in favor of these pre-service teachers at KKU (EM = 1.417).
- PK (F (2, 520) = 4.441, p = .012) in favor of these pre-service teachers at KKU (EM = 4.230.
- TPK (F (2, 520) = 4.276, p = .014) in favor of these pre-service teachers at KKU (EM = 2.841.
- TPACK (F (2, 520) = 3.014, p = .007) in favor of these pre-service teachers at KKU (EM = 3.133).

Also, there was a significant interaction between the computer usage skills level factor and the institution in the following TPACK knowledge areas among the pre-service teachers:

- CK (F (4, 520) = 4.800 p = .001)
- PK (4, 520) = 2.917 p = .021)
- TPK (4, 520) = 4.202 p = .002)
- TPACK (4, 520) = 2.625 p = .034)

As this list shows, only pre-service teachers' TK, PCK, and TCK did not show any interaction with computer usage skills.

The tests show the higher the computer usage skills, the less knowledge they gained from their teacher training program in their TK and TPACK at all three institutions. Also, TU and KFU have a small difference in pre-service teachers' CK and TPK in the computer usage skills factor. Furthermore, as pre-service teachers' computer usage skills level increase, their TCK and PCK level decrease at KFU. Similarly, as pre-service teachers' computer usage skills level increase, their TK, CK, PCK, TCK, TPK, and TPACK level decrease at KKU.

Discussion

Demographics. The demographics data collected included gender, computer usage skills level, and the teacher preparation program attended. In regards to gender, the majority of the participant in the survey were female (74.5%). The oversampling of female pre-service teachers may have influenced the results. Concerning the level of computer usage skills, current level reported by most of the participants was moderate (60.1%). The oversampling of pre-service teachers who had a moderate level of computer usage skills may have influenced the results. Regarding the teacher preparation program, the majority of respondents attended Taif University (43.1%) at the time of the survey, followed by King Khalid University (38.8%), and lastly, King Faisal University (18.1%). The oversampling of pre-service teachers who attended Taif University or King Khalid University may have influenced the results.

Research question one. The first research question asked, "Is there a significant increase in the perceived knowledge level of pre-service teachers with regards to Koehler and Mishra TPACK model by the end of the training program in their Saudi university?" The results indicate that there was increase in the perceived knowledge level of pre-service teachers based on Koehler and Mishra's TPACK model by the end of the training program. This result agreed with

the related literature that there are significant differences before and after the implementation of the program in the level of application of teachers to the technology and methods of teaching subjects of mathematics (Durdu & Dag, 2017). The results showed the effectiveness of the training program in developing positive attitudes towards the TPACK model and developing the teachers' ability to transform theoretical ideas into practice in the classroom (Bate, Day, & Macnish, 2013).

Angeli and Valanides (2014) stressed that pre-service teachers' preparation programs are "charged with establishing the knowledge needed for entry-level teaching" (p. 28). That could be achieved through four groups of courses related to technology, content, methods, and practice/internship experiences. Today, students actively participate in these programs with new and emerging digital techniques that have been produced in the 21st century that may have an active role in developing their TPACK. This increase makes sense in the teacher preparation program because students have the first time enrolled in a teaching methods course and educational technology course (Bingimlas, 2018; Fouda, 2017; Gill & Dalgarno, 2017; Hofer & Grandgenett, 2012).

Research question two. The second research question asked, "Is there a significant difference in the perceived knowledge level of pre-service teachers between male and female by the end of the training program in their Saudi university?" The results indicate that pre-service teachers' TK, CK, PK, PCK, TCK, TPK, and TPACK varied by gender. Even though the majority of the participants were Female (74.5%) the results in pre-service teachers' TK, CK, PK, PCK, TCK, TPK, TPACK were significant difference in favor of the male group.

Most of the literature has examined TPACK subdomains but only a few of them examined TPACK subdomains according to gender. Kartal and Afacan (2017) indicated that males have high levels in their knowledge related to technology because they have a more positive and confident with regard to technology. Koh et al. (2010) reported that there was a significant difference in CK, TK, and TPK in favor of the male group. Similarly, Erdogan and Sahin (2010) found that there was a significant difference in TPACK, TCK, TPK, PCK, and TK in favor of the male group.

Moreover, this result agreed with the related literature by Can, Erokten, and Bahtiyar (2017) that pre-service teachers' TPACK can affect by the demographic variables (gender, computer usage level and grade level). Bingimlas (2018) stressed that there are differences between of in-service teachers from the Kharj District of Saudi Arabia in their TPACK based on gender, teaching subjects, and teaching experience.

However, this result differed from the findings of Xu, Zhu, and Tang (2018), who reported that even though the pre-service teachers had excellent TPACK competence the demographic variables (gender, subject, and background), there was no significant effect on the pre-service teachers' TPACK competence. Likewise, a meta-synthesis study conducted by Yilmaz (2015) found no meaningful relationship between gender and TPACK in Turkey.

Moreover, Kartal and Afacan (2017) explain that pre-service science teachers' experiences in technology and teaching in their teachers preparation program have a positive impact on TPACK. However, demographic variables (gender, computer usage level, and grade level) had a different effect on their TPACK some small others higher. So, Kartal and Afacan (2017) suggest that more studies about pre-service teachers' TPACK should be performed because TPACK

surveys reveal different models with different factors when conducted with various participants.

However, in the education system in Saudi Arabia, such as the school system and teacher preparation programs, males and females are taught separately, which differs from most other countries and may have influenced the results.

Moreover, the results from ANOVA shows that there was a significant difference for the institution factor in the most of pre-service teachers' TK, CK, PK, TCK, and TPACK in favor of these pre-service teachers at KKU. Also, there was no significant difference for the institution factor in the pre-service teachers' PCK and TPK. Moreover, there was a significant difference for gender interaction factor with the institution in pre-service teachers' TK, CK, and TCK. Similarly, the figures of the interaction plots show that there was a clear difference in pre-service teachers' TK, CK, and TCK between male and female groups at King Khalid University and this difference was in favor of male group. These results showed that pre-service teachers in this study need more support for TK, CK, and TCK as they enter teacher training program.

Moreover, one of the most important findings from these results was that there was no significant interaction between gender and the institution in the pre-service teachers' knowledge that related to the pedagogy types knowledge, which are PK, PCK, TPK, and TPACK. This result agreed with the related literature, which shows that male teachers report being more competent than female teachers in all TPACK constructs (Erdogan & Sahin, 2010). Also, there was no significant difference in the two domains (pedagogy and content), it was significant in the other five dimensions (Erdogan & Sahin, 2010).

Alhababi (2017) found that teachers largely supported the use of digital technology in the classroom and encouraged students to use technology for their educational purposes. However, teachers pointed out that educational institutes in Saudi Arabia are not fully qualified or equipped for mobile learning, so there will be more time required to ensure that both teachers and students rely on digital technologies for their lessons and knowledge transfer. Alhababi (2017) recommended the need for support staff and support staff training to allow teachers in Saudi Arabia to integrate technology in meaningful ways at the classroom level.

These findings may affect the pre-service teachers' practical training when the place for training is not fully qualified or equipped to learn using technology. Also, the teacher practicum for the participants in this study ranged from six to eight teacher practicum credit hours, which may explain why their pedagogical knowledge (PCK, TPK, and TPACK) did not improve, since they may not have had enough time to actually practice what they learned. Bingimlas (2018) argued that teachers should change their teaching methods from traditional learning methods to active learning methods by using technology. Thus, the Ministry of Education in Saudi Arabia should focus on providing both girls' and boys' schools with educational technologies and training them to use these technologies effectively.

Lastly, for research question two, the researcher determined from these results that there was a significant difference according to their gender interaction with the institution in the pre-service teachers' knowledge related to

technology and content, which are TK, CK, and TCK. The educational technology courses undertaken during their teacher training program might have also contributed to this increase.

Research question three. The third research question asked, "Is there a significant difference in the perceived knowledge level of pre-service teachers depending on their computer usage skills level by the end of the training program in their Saudi university?" The results from ANOVA shows that there was a significant difference for computer usage skills level in the most of pre-service teachers' knowledge (TK, CK, PCK, TCK, TPK, and TPACK) except pre-service teachers' PK in favor of these pre-service teachers in the Beginner level. Also, there was a significant difference for the institution factor in the pre-service teachers TK, CK, PK, TPK, and TPACK except pre-service teachers' PCK and TCK. Also, there was a significant difference for the interaction of computer usage skills with the institution in the pre-service teachers CK, PK, TPK, and TPACK except pre-service teachers' TK, PCK and TCK. These results are possibly because teacher preparation programs provide limited experiences about teaching and learning in their content area with technology to pre-service teachers (Can et al., 2017).

The results show that the higher the computer usage skills of the participant, the less knowledge they reported having gained from their teacher training program in their TK and TPACK at all three institutions. Also, TU and KFU pre-service teachers showed a small difference in their CK and TPK in the computer usage skills factor. Furthermore, as pre-service teachers' computer usage skills level increase, their TCK and PCK level decrease at KFU. Similarly, as pre-service teachers' computer usage skills level increase, their TK, CK, PCK, TCK, TPK, and TPACK level decrease at KKU, which means pre-service teachers in the Beginner level group of computer usage skills will likely benefit from their teacher training program more than the higher levels, while the benefit of the training program on the computer usage skills of the Professional level is limited. This result was opposite with the related literature by Kartal and Afacan (2017), which showed as pre-service science teachers' efficacy levels in using computers increase, their TPK, KP, TK and CK levels also increases.

Conclusions

This study examined Saudi pre-service teachers' technological pedagogical content knowledge (TPACK) in their training program in Saudi universities. It also examined the impact of their training program on their TPACK knowledge level with respect to the following variables: gender, computer usage skills level, their teacher preparation program, and grade level.

The benefits and the advantages of knowing the findings of pre-service teachers' TPACK of this study can help instructional designers to think about the course they design for pre-service teachers in order to meet their needs on how to integrate technology. Also, knowing the findings of pre-service teachers' TPACK can help to develop a successful professional development program (PDP) that builds on the needs of pre-service teachers. Moreover, these findings can help prepare pre-service teachers to integrate technology in the classroom to meet 21st-century skills (Srisawasdi, 2014). The findings of pre-service teachers' TPACK can also help the researcher to understand their use of technology in the

classroom. Lastly, the findings showed the degree to which the training programs at Saudi universities prepare pre-service teachers to integrate technology into their teaching and improve their TPACK.

The findings of the study report that pre-service teachers' TPACK can be affected by the gender and computer usage skills level. Moreover, this study indicated the increase in all of the perceived knowledge level of pre-service teachers' TPACK model by the end of their training program in their Saudi university. Similarly, there was a significant difference in all of the pre-service teachers' TPACK according to their gender and this difference was in favor of male group, even though the majority of the participants in the survey were Female (74.5%). The findings also report that the higher the computer usage skills, the less knowledge they will gain from their teacher training program in their TK and TPACK at all three institutions.

This study also indicated that there was no clear difference in most of pre-service teachers' TPACK who completed the teacher preparation program at TU, even though this program was recently updated based on advanced international standards through TU's partnership with the United Nations Educational, Scientific Cultural Organization (UNESCO) Regional Center. Additionally, TU is a developer program that has approval from the Ministry of Education. Given the amount of attention and emphasis placed on TU's updated program, the limited findings from the present study necessitate a closer look at the TU training program.

Moreover, the findings of the study report that there was a significant difference in most pre-service teachers' TPACK according to grade level, gender, and computer usage skills in favor of KKU. Updates to the KKU program are currently in development, but the participants in this study completed the old program. It will be interesting to study the groups that complete the updated program and compare them to these findings in order to see whether the changes improved or hurt the TPACK outcomes.

Importantly, the findings of this study are limited to pre-service teachers in general to subjects at Saudi universities. Because this study was conducted in the KSA, it does not provide information about what occurs in other countries and cannot be easily generalized teacher preparation programs outside of the KSA. The findings can, however, be generalized to other teacher preparation programs at Saudi universities since all pre-service teachers in the KSA are part of one education system under the Ministry of Education.

Finally, it is important to reiterate that the education system in Saudi Arabia, including the teacher preparation programs, separate males and females, which is different than most schools in most other countries, which may have influenced the results. Therefore, there is a need to examine TPACK subdomains according to gender to have better understanding of the gender differences, also to develop teacher preparation programs at Saudi University.

Recommendations for Future Research

The results of this study indicate that there are significant differences in pre-service teachers' technological pedagogical content knowledge (TPACK) in their training program in Saudi universities according to their characteristics among their institutions. Based on this research, recommendations for future research that would help designing or to redesign their teacher training program in Saudi universities.

In this study, it was determined there were statistically significant differences in the pre-service teachers' TK, CK, PK, PCK, TCK, TPK, and TPACK by gender in favor of the male group. Therefore, more studies examined TPACK subdomains according to gender should be performed because TPACK surveys reveal different models with different factors when conducted with various participants. Also, the Ministry of Education in Saudi Arabia should focus on providing both girls 'and boys' schools with educational technologies and training them to use these technologies effectively.

In this study, it was also determined there was a clear difference in pre-service teachers' TK, CK, and TCK between male and female groups at King Khalid University and this difference was in favor of male group. Therefore, pre-service teachers in the female group in this study need more support for TK, CK, and TCK as they enter teacher training program.

It was also determined that the higher the computer usage skills, the less knowledge they will gain from their teacher training program in their TK and TPACK at all three institutions. A qualitative research study would a provide a deeper understanding of the differences in computer usage skills for pre-service teachers in regards to their TPACK.

Lastly, the findings indicated that there was no clear difference in most of the pre-service teachers' TPACK who graduated from the teacher preparation program at the TU even though it is recently developed. Therefore, more studies should be performed to examine TPACK subdomains according to institutions.

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