THE ALIGNMENT OF TEACHER EDUCATION PROGRAMS WITH THE TPACK FRAMEWORK AND THEIR READINESS TO PREPARE PRE-SERVICE TEACHERS TO INTEGRATE TECHNOLOGY IN THEIR FUTURE TEACHING

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The Alignment of Teacher Education Programs with the TPACK Framework and Their Readiness to Prepare Pre-Service Teachers to Integrate Technology in Their Future Teaching

DOCTORAL THESIS

Supervised by Dr. Janaina Minelli De Oliveira Ramos

Doctoral Program in Humanistic Studies

Tarragona
2023

UNIVERSITAT ROVIRA i VIRGILI

FAIG CONSTAR que aquest treball, titulat “The Alignment of Teacher Education Programs with the TPACK Framework and Their Readiness to Prepare Pre-Service Teachers to Integrate Technology in Their Future Teaching”, que presenta Jihan Hussein Khalifeh Mohamad per a l’obtenció del títol de Doctor, ha estat realitzat sota la meva direcció al Departament de Pedagogia d’aquesta universitat.

HAGO CONSTAR que el presente trabajo, titulado “The Alignment of Teacher Education Programs with the TPACK Framework and Their Readiness to Prepare Pre-Service Teachers to Integrate Technology in Their Future Teaching”, que presenta Jihan Hussein Khalifeh Mohamad para la obtención del título de Doctor, ha sido realizado bajo mi dirección en el Departamento de Pedagogía de esta universidad.

I STATE that the present study, entitled “The Alignment of Teacher Education Programs with the TPACK Framework and Their Readiness to Prepare Pre-Service Teachers to Integrate Technology in Their Future Teaching”, presented by Jihan Hussein Khalifeh Mohamad for the award of the degree of Doctor, has been carried out under my supervision at the Department of Pedagogy of this university.

[Tarragona], [15/11/2023]

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Dedication

"To the memory of my beloved father, Hussein, whose belief in my dreams continues to guide me, even though he is no longer with us. You have been a constant source of inspiration throughout my academic journey.

To my beloved mother, Fatima, whose boundless love, sacrifices, and steadfast encouragement have been the driving force behind my achievements. Your endless support has played an indispensable role in my accomplishments, and I carry your love in my heart with every step I take.

To my loving siblings, Imad and Suzan, and my dearest friends, Maya, Youmna, Sariya, Noha, Dina, and Abir, whose unwavering support and encouragement have been my constant source of strength.

To my nephews, Jad and Imad, whose smiles and hugs have helped me overcome any obstacle I have faced during this journey.

This dissertation is a testament to your enduring belief in me, and I dedicate it to you with immense gratitude and love."

Acknowledgement

I wish to express my deepest gratitude to the many individuals who have contributed to the completion of this dissertation. Their support, guidance, and encouragement have been instrumental in this academic journey.

First, I am immensely grateful to my academic advisor, Dr. Janaina Minelli De Oliveira Ramos, for her guidance, expertise, and patience throughout this research endeavor. Your insights and wisdom have been invaluable in shaping the quality of this dissertation.

I also owe gratitude to a group of individuals whose motivation, collaboration, and relentless cooperation were instrumental in finalizing my dissertation. I would like to specifically thank Dr. Anwar Kawtharani, Dr. Dina Shouman, and Mr. Levon Momdjian for facilitating my data collection and providing me with all the support I needed to conduct my study.

My appreciation also goes to the participants from the Lebanese International University, including pre-service teachers, in-service teachers, teacher educators, and administrators, for their input to this study.

This dissertation is the result of collective effort and support, and I am truly grateful for the privilege of learning from and working with such outstanding individuals. Thank you for being part of this significant chapter in my academic life.

List of Abbreviations

TEP	Teacher Education Program
TPACK	Technological Pedagogical and Content Knowledge
TK	Technological Knowledge
PK	Pedagogical Knowledge
CK	Content Knowledge
TPK	Technological Pedagogical Knowledge
TCK	Technological Content Knowledge
PCK	Pedagogical Content Knowledge
ICT	Information and Communication Technology
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
AI	Artificial Intelligence

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The Alignment of Teacher Education Programs with the TPACK Framework and Their Readiness to Prepare Pre-Service Teachers to Integrate Technology in Their Future Teaching

Abstract

This study aims at studying the alignment of teacher education programs (TEP) in one private university in Lebanon with the TPACK framework and their readiness to prepare pre-service teachers to integrate technology in their future teaching. It studies the perceived TPACK level of pre-service and in-service teachers (who graduated from the same university under study). This study also explores the recommendations and best practices to transform the techno-pedagogical competencies to pre-service teachers and the impediments that may hinder this transformation. A mixed-method triangulation approach was adopted. Quantitative data were collected based on the TPACK survey that was filled out by 187 pre-service teachers and 52 in-service teachers. Qualitative data were collected from interviews with 6 administrators, 21 teacher educators, 20 in-service teachers, and 57 pre-service teachers, in addition to document analysis of 45 syllabi of both undergraduate and graduate TEP courses. The survey results show that both pre-service and in-service teachers have a positive perception of their own TPACK level and that there are no significant differences in the TPACK scores between them. The interviews highlight some major impediments to integrating technology at the national, institutional, teacher, and student levels. They also provide some recommendations related to the teaching and learning process and others related to conducting workshops and trainings, getting motivation and support from upper management, and revisiting the TEP curriculum. In addition, the syllabi analysis shows that the TPACK construct was never addressed in any course outcome, contrary to CK which was addressed in all syllabi, followed by PK and PCK. A major conclusion of this present study is that the TEP at this university doesn't fully align with the TPACK framework, especially when it comes to the pedagogy of using technology and to the intersection of the three constructs, or the TPACK. It is suggested that the improvement of such alignment could be accomplished by overcoming the impediments to integrating technology identified in this study, such as the weak infrastructure, limited technological resources, the curriculum, teachers' limited technological skills, and teachers' limited pedagogical knowledge in using technology. This study hopes to contribute to improving the educational system in Lebanon as it sheds light on the best practices and the impediments to effectively integrate technology in the teacher education program, thus consequently providing future teachers with the skills needed in the 21st century. Also, this study aims at providing educators, decision-makers, and policymakers with some information that would help them in their teacher education program reform.

Keywords TPACK framework . Technological Pedagogical Content Knowledge . Teacher education programs . Higher education . Pre-service teachers . In-service teachers

Resumen

Este estudio tiene como objetivo investigar la alineación de los programas de formación docente (PFD) en una universidad privada en Líbano con el marco de trabajo TPACK y la preparación de estos programas para capacitar a los futuros docentes en la integración de la tecnología en su enseñanza futura. Se estudia el nivel de TPACK percibido por los docentes en formación y en servicio (que se graduaron de la misma universidad en estudio). Este estudio también explora las recomendaciones y mejores prácticas para transformar las competencias tecno-pedagógicas a los docentes en formación y los impedimentos que pueden obstaculizar esta transformación. Se adoptó un enfoque de triangulación de métodos mixtos. Los datos cuantitativos se recopilaron en base a la encuesta TPACK que fue completada por 187 docentes en formación y 52 docentes en servicio. Los datos cualitativos se recopilaron a partir de entrevistas con 6 administradores, 21 formadores de docentes, 20 docentes en servicio y 57 docentes en formación, además del análisis de documentos de 45 programas de cursos de PFD tanto de pregrado como de posgrado. Los resultados de la encuesta muestran que tanto los docentes en formación como en servicio tienen una percepción positiva de su propio nivel de TPACK y que no hay diferencias significativas en las puntuaciones de TPACK entre ellos. Las entrevistas destacan algunos impedimentos importantes para integrar la tecnología a nivel nacional, institucional, docente y estudiantil. También proporcionan algunas recomendaciones relacionadas con el proceso de enseñanza y aprendizaje y otras relacionadas con la realización de talleres y capacitaciones. Los participantes consideran importante que se obtenga motivación y apoyo de la alta dirección, además de que se debe revisar el currículo del programa de formación docente (PFD). Además, el análisis de los programas muestra que la construcción de TPACK nunca se abordó en ningún resultado del curso, a diferencia del CK que se abordó en todos los programas, seguido por PK y PCK. Una conclusión importante de este estudio es que el PFD en esta universidad no se alinea completamente con el marco de trabajo TPACK, especialmente en lo que respecta a la pedagogía del uso de la tecnología y a la intersección de los tres constructos, o el TPACK. Se sugiere que la mejora de tal alineación podría lograrse superando los impedimentos para integrar la tecnología identificados en este estudio, como la infraestructura débil, recursos tecnológicos limitados, el currículo, habilidades tecnológicas limitadas de los docentes y conocimientos pedagógicos limitados de los docentes en el uso de la tecnología. Este estudio espera contribuir a mejorar el sistema educativo en Líbano, ya que arroja luz sobre las mejores prácticas y los impedimentos para integrar efectivamente la tecnología en el programa de formación docente, proporcionando así a los futuros docentes las habilidades necesarias en el siglo XXI. Además, este estudio tiene como objetivo proporcionar a los educadores, responsables de la toma de decisiones y formuladores de políticas información que les ayude en la reforma de su programa de formación docente.

Palabras clave Marco TPACK . Conocimiento Tecnológico Pedagógico de Contenidos . Programas de formación docente . Educación superior . Profesores en formación . Profesores en servicio.

Chapter 1: Introduction

Technology has become an integral component of contemporary society, transforming many facets of our lives, including education. The integration of technology in the field of education has the potential to improve teaching and learning, thereby preparing students to be successful in an increasingly digital world. To realize the maximum potential of technology in education, it is essential to equip teachers with the knowledge and skills required to integrate technology into their teaching practices. This requires a thorough analysis of teacher education programs (TEPs) and their alignment with frameworks that promote technology integration. This integration, however, requires more than a simple comprehension of technology; it requires a careful alignment of pedagogical strategies, content knowledge, and technological understanding, a concept known as Technological Pedagogical Content Knowledge (TPACK). The TPACK framework is a useful paradigm for teachers navigating the complex interaction between these elements in their practice.

In Lebanon, as in several other countries, the process of incorporating technology into teacher education programs (TEPs) is ongoing and requires a lot of research and exploration.

1.1 Background of the Study

The higher education sector has a crucial role in preparing individuals for the knowledge-based economy of the twenty-first century (EC, 2003; NA, 2007; NCIHE, 1997). However, there is a rising concern that graduates are not being adequately prepared with the skills required to thrive in today's ever-changing work environment, resulting in lower productivity (EC, 2003; Leitch, 2006; NCIHE, 1997; Packer, 1993; SCANS, 1991). Education is critical to delivering the skill set required for success in today's job market. Thus, stakeholders in the education sector must prioritize the integration of 21st-century skills, including technology, into academic programs, especially for pre-service teachers at the teacher education program. As cited by several authors (Berry et al., 2010; Farooq & Shahzadi, 2006), the quality of educational programs highly impacts teachers' performance. This integration is critical not only for future educators' career success but also for their students' achievement as future citizens. Pre-service teachers must acquire this century's required knowledge and skills in order to reflect them in the classes they will be teaching when they graduate. The incorporation of 21st-century skills into teacher education programs benefits not only instructors and students but also the entire quality of education at the national level.

1.2 Problem Description

Students today have grown up in a world where technology is one of the essential elements that cannot be separated from the activities done in daily life, including the crucial function it plays in the modern classroom. Although technology may have a significant role in restructuring teaching and learning methods, teachers must take the lead in creating the ideal learning environment and selecting the appropriate technological learning materials in order to help students learn effectively. The traditional information-based paradigm of society has changed, and as a result, diverse knowledge and skills are valued more highly. A teacher should be able to use digital technology to help students develop the abilities they need to succeed in

the 21st century when they first enter the workforce. The integration of technology in education helps students transition from being passive information and technology consumers to active creators and collaborators in the global community.

In Lebanon, education professionals have been urging public and private institutions to review the schooling system, which dates back to 1993. Because it lacks the necessary survival techniques to keep up with its constantly changing environment, Lebanon's education sector has been left vulnerable to the effects of globalization.

The competencies of pre-service teachers in Lebanon don't reach the norms in other nations with comparable educational systems, claim Soueid et al. (2014). In addition, the limited research on 21st century skills in the Lebanese educational system reveals that neither the national curriculum nor teachers nor institutions of higher learning adequately address these skills (BouJaoude, 2002; Ghaith, 2010; Ghamrawi et al., 2017).

As a result, integrating teacher education programs with the TPACK framework and assuring pre-service teachers' ability to integrate technology into their future teaching methods is critical. This alignment not only addresses the issue of underprepared graduates, but it also adds to the general development of a skilled workforce capable of flourishing in the knowledge-based economy of the twenty-first century.

1.3 Purpose of the Study

The purpose of this study is threefold. First, it seeks to study the alignment of the TEPs at one Lebanese university with the TPACK framework, thereby assessing their readiness to prepare pre-service teachers to integrate technology into their future teaching.

Second, the study aims to investigate the self-perception of TPACK among educators at various levels: undergraduate and graduate pre-service teachers at the TEP in a Lebanese university and in-service teachers who have graduated from the same university. It is posited that educators' perceptions of their TPACK capabilities will provide invaluable insights into the effectiveness of these TEPs.

Third, this study explores the recommendations, best practices, and impediments to integrating technology in TEPs. By gathering input from pre-service teachers, in-service teachers, and faculty staff, this study aims to provide a comprehensive perspective on the challenges and opportunities presented by the infusion of technology into teacher education programs.

1.4 Research Questions

In this study, the following research questions will be tackled:

1. What are the participants' perceptions of their own TPACK level?
2. What are the main impediments that may hinder the successful integration of technology in teacher education programs?
3. What are the recommendations to effectively integrate technology into teacher education programs?
4. What are the best practices for integrating technology in teacher education programs?
5. Do TEPs at this Lebanese university prepare pre-service teachers to integrate technology into their future teaching?

1.5 Rationale of the Study

The rationale for this study is rooted in the emergent importance of technology in education and the need to ensure that teacher education programs (TEPs) effectively prepare educators to integrate technology into their teaching practices. This research seeks to address several gaps in the existing literature on technology integration in teacher education programs (TEPs) in Lebanon.

First, there has been limited research conducted on the alignment of TEPs in Lebanon with the Technological Pedagogical Content Knowledge (TPACK) framework. While TPACK has been widely acknowledged as a useful framework for governing technology integration in education (Mishra & Koehler, 2006), there is a dearth of research examining the extent to which TEPs in Lebanon align with this framework. This study will provide empirical evidence and insights regarding the current alignment of TEPs at a Lebanese university with the TPACK framework, thus contributing to filling this research gap.

Second, there is a lack of research on the self-perception of TPACK among educators in Lebanon, both pre-service and in-service teachers. While studies have examined TPACK self-perception in a variety of contexts (Angeli & Valanides, 2009; Schmidt et al., 2009), there is a lack of research on the perceptions of educators in Lebanon. By investigating the self-perception of TPACK among educators at a Lebanese university, this study will contribute to reducing this knowledge gap and providing an extensive understanding of the TPACK self-perception among Lebanese educators.

Additionally, there is a need to investigate the recommendations, best practices, and barriers to technology integration in TEPs in Lebanon. Existing research has examined these aspects in a variety of international contexts (e.g., Sánchez-Garca et al., 2020; Voogt et al., 2013), but studies concentrating specifically on the Lebanese context are scarce. Through the collection of insights and perspectives from pre-service teachers, in-service teachers, and faculty staff, this study will address this gap and offer valuable recommendations and best practices for enhancing technology integration in TEPs in Lebanon.

Finally, little research has been conducted on the readiness of pre-service teachers in Lebanese TEPs to integrate technology into their prospective teaching. While research has been conducted on the integration of technology in teacher education programs (e.g., Ottenbreit-Leftwich et al., 2010; Zhao et al., 2002), there is a lack of research concentrating on the Lebanese context. By evaluating the readiness of pre-service teachers at a Lebanese university, this study will contribute to filling this disparity and providing insight into the current situation in terms of readiness for technology integration among future teachers in Lebanon.

In summary, this study will address research gaps by examining the alignment of TEPs at a Lebanese university with the TPACK framework, exploring the self-perception of TPACK among educators, gathering impediments, recommendations, and best practices, and assessing pre-service teachers' readiness for technology integration. By concentrating on the Lebanese context, this study will provide insightful information and will contribute to the existing body of knowledge in the field of technology integration in teacher education.

1.6 Significance of the Study

The significance of this study extends to several stakeholders in the field of education, including pre-service teachers, in-service teachers, teacher educators, university administrators, and educational policymakers, in addition to the teacher education program, educational institutions, and the national educational system.

The purpose of this study is to evaluate the readiness of teacher education programs to prepare pre-service teachers to integrate technology into their future teaching practices. By examining the alignment of TEPs with the TPACK framework, pre-service teachers can gain insight into their own technological integration preparation's strengths and areas for improvement. This study's findings can inform curriculum enhancements and professional development opportunities designed to equip pre-service teachers with the knowledge and skills necessary for effective technology integration.

In-service educators will also benefit from this research. By investigating educators' self-perceptions of TPACK, in-service teachers can ruminate on their own technological competencies and identify areas for improvement. The study's recommendations and best practices can serve as a guide for in-service instructors seeking to improve their technology integration skills, potentially resulting in enhanced instructional practices and increased student engagement.

Teacher educators have a significant impact on the future of education. This study can provide valuable insight into the strengths and shortcomings of the current teacher education program in terms of technology integration. The findings can inform teacher educators about areas requiring attention, thereby facilitating the development of tailored instructional approaches and strategies for effectively preparing future teachers. In addition, teacher educators can incorporate the recommendations and best practices identified in this study to

improve their own pedagogical practices and assist pre-service and in-service teachers on their technology integration journey.

This study provides stakeholders, including educational policymakers, administrators, and educational institutions, with an in-depth understanding of the current state of technology integration in teacher education. The findings can inform decision-making processes, curriculum development, and resource allocation in support of efforts to integrate technology. By aligning TEPs with the TPACK framework and implementing the recommendations and best practices identified in this study, stakeholders can contribute to the overall improvement of education and ensure that future educators are prepared to thrive in a technology-rich learning environment.

This investigation can benefit both the university under study and the country as a whole. The university under study can use the findings to evaluate and improve its teacher education program, making it more adaptable to the demands of the digital age. The recommendations of the study can help the university implement necessary changes, enhance its reputation, and attract prospective students who value technology integration in teacher education. The study can serve as a catalyst for educational reform in Lebanon, promoting the effective incorporation of technology into teacher education programs nationwide. This can result in improved educational outcomes, increased digital literacy among teachers and learners, and the development of a workforce ready to thrive in a technologically advanced society.

In summary, this study has significant implications for pre-service teachers, in-service teachers, teacher educators, university administrators, the teacher education program, educational institutions, and the national educational system. It has the potential to positively impact the quality of education and the future of teaching and learning in Lebanon by addressing the gaps in technology integration, offering recommendations and best practices, and nurturing a culture of innovation in teacher education.

1.7 Interpretation of the General Terms Used

Below are the definitions for some of the main terminologies used in this study:

a. Teacher Education Program: A Teacher Education Program (TEP) is a structured course of study offered by a higher education institution that prepares individuals for careers as teachers. TEPs typically consist of coursework, field experiences, and pedagogical instruction to develop the necessary knowledge, skills, and dispositions needed for effective teaching (Darling-Hammond, 2006).

b. Pre-service teachers: Pre-service teachers are individuals presently enrolled in a Teacher Education Program (TEP) and undergoing preparation to become teachers but have not yet begun their professional teaching career (Korthagen et al., 2016).

c. In-service teachers: In-service teachers are practicing teachers who have concluded their formal teacher education and are currently working as educators in schools or other educational institutions (Darling-Hammond & Bransford, 2005).

d. Teacher educators: Teacher educators are higher education professionals who are responsible for the preparation and development of pre-service teachers. They teach, guide, and support the professional growth and development of pre-service teachers (Feiman-Nemser & Buchmann, 1985).

e. Cooperating teachers: Cooperating teachers, also known as supervising teachers or mentor teachers, are credentialed and experienced educators who host and supervise pre-service teachers during their field experiences and student teaching placements. They provide pre-service teachers with guidance, mentoring, and support as they develop their teaching abilities (Cuenca et al., 2019).

1.8 Overview of the Dissertation

This dissertation is divided into six chapters. The first chapter (Introduction) describes the topic and provides the background of the study, problem description, purpose of the study, research questions, rationale and significance of the study, and interpretation of the general terms used. The second chapter (Theoretical Framework) explains the main framework for this study and highlights several scholarly reviews about the topic at hand. The third chapter (Methodology) describes the research design, participants, instruments, data collection and analysis procedures, and the ethical considerations pertaining to this study. The fourth chapter (Results) provides the results of the qualitative and quantitative data used in this study. The fifth chapter (Analysis) answers the research questions and provides an analysis of the study results. The last chapter (Conclusion) concludes the study. It summarizes the study objectives, methodology, and findings and provides the research contributions, implications, recommendations, limitations, and suggestions for future studies.

Chapter 2: Theoretical Framework

2.1 Introduction

Information and communication technology (ICT) has witnessed rapid development in recent years and has imposed inevitable changes on us. These changes are moving at a very fast pace compared to what one could have imagined twenty or thirty years ago (Spector, 2010). They have affected almost all sectors, including the economic ones, which now consider 21st century skills, and more specifically, ICT skills, as major requirements that should be present in today's workforce. This changing global economy, along with the information age and the new demands for being a global citizen, have led to a movement and a call to reform the current educational systems to include 21st century skills (Ellis, 2012).

Artificial intelligence (AI) is a key part of this rapidly changing technology world. It is leading to major changes in various industries, altering the kinds of skills people need, and opening up new job possibilities. In the past five years, there has been a significant increase in the application of artificial intelligence (AI) in higher education (Chu et al., 2022), along with a rapid growth in the availability of new AI tools. Several studies have discussed the advantages of AI in higher education. Some of these benefits are promoting personalized and interactive learning (Baidoo-Anu & Ansah, 2023), helping educators in preparing assessments (Baykasoğlu et al., 2018), adapting the instruction to meet the needs of students with different learning styles (Verdú et al., 2017), offering tailored and immediate feedback (Dever et al., 2020), and predicting students' academic success (Çağataylı & Çel- ebi, 2022). Fauzi et al. (2023) found out that in this modern digital era, AI like ChatGPT has the potential to greatly enhance student productivity. It can assist students by offering valuable resources, aiding in language skill development, encouraging teamwork, boosting time management and productivity, and giving support and encouragement.

As AI starts to enhance and sometimes even replace human work, our education systems need to adjust. This means not just teaching students how to use these new technologies but also encouraging them to think critically, be creative, and easily adapt to changes. These skills are essential for succeeding in a future where AI plays a big role. In light of these developments, it's essential for education systems to reevaluate their curriculum objectives and methods of teaching. These educational systems are required now more than ever before to renew themselves in order to keep pace with all these advancements, including AI, and to equip students with all the emerging skills demanded by the labor market. According to Mishra et al. (2023), students should be equipped with knowledge that is relevant for the current and future job market, which includes new types of content knowledge shaped by the progress in generative artificial intelligence. As for educators, it's crucial that they constantly consider what essential knowledge students need to be ready for a future that's uncertain and evolving, especially in a world where AI technologies will significantly alter jobs and the economy.

This situation requires students nowadays to acquire a different set of skills compared to students of the previous century (Miranda et al., 2014). Schools in the past were asked to teach the basic skills (reading, writing, and math) necessary for employment at that time, whereas schools nowadays are asked to provide students with the basic skills in addition to the 21st

century competencies. Students nowadays are also expected to know how to purposefully and effectively use ICT as a tool to facilitate the different practices of 21st century skills like learning, communicating, collaborating, problem-solving, and thinking critically and creatively. One method that would expedite this is to integrate technology into teaching.

In response to these changes, several countries and governmental initiatives around the world have been supporting the integration of technology at educational institutions in the past years (Beauchamp et al., 2015; Chen & Jang, 2014; Liu, 2011; Scheiter & Lachner, 2019; Tamim et al., 2015), and many governments and policymakers have been investing in instructional technologies. However, despite these efforts, schooling systems are found to be unable to prepare students for the demands of this century (Daggett, 2005; Eisen et al., 2005; Houle & Cobb, 2011; Partnership for 21st Century Skills & Vockley, 2006; Tucker, 2007). For instance, Bushaw and Lopez (2012) have reported that less than 20% of high school graduates possess the 21st century skills required for professional success. Universities, as well, have been criticized for not providing their graduates with these skills (Arum & Roksa, 2011; Pietka, 2007; Taylor, 2010). This includes teacher education programs that are offered by different educational institutions worldwide (Brown & Warschauer, 2006).

To prepare learners for this industrial era, teacher education programs should train pre-service teachers to effectively integrate technology in teaching (Mwapwele et al., 2019). The change should thus start at the teacher education programs. Highly qualified teacher educators who adopt the best practices in technology integration will train pre-service teachers on these skills, and they in turn will train their students on using technology.

Teacher education programs must train pre-service teachers on how to select, assess, and use the most suitable technologies relevant to the subject matter they teach. This requires developing pre-service teachers' technological, pedagogical, and content knowledge and their ability to integrate these knowledge components together. This could be done by modifying the curriculum to explicitly model the teacher educator's synthesized technological, pedagogical, and content knowledge and by providing opportunities for future teachers to practice this synthesis throughout the duration of the program. This could also be reinforced during field placements at schools. The school environment, mentor teachers' modeling and support to integrate technology, and the role assigned to pre-service teachers during the field placements also support this goal.

One widely recognized model that describes technology integration in teaching is the technological pedagogical content knowledge (TPACK) model (Mishra & Koehler, 2006).

2.2 Framework Background

The TPACK framework is rooted in the pedagogical content knowledge (PCK) model developed by Shulman (1986). In 2006, Punya Mishra and Matthew Koehler suggested that educational technology cannot stand alone, and that it could be added to Shulman's pedagogical knowledge model. Koehler and Mishra (2009) then proposed seven sub-domains

that fall under their framework. These subdomains are: content knowledge (CK), pedagogical knowledge (PK), technology knowledge (TK), pedagogical content knowledge (PCK), technological content knowledge (TCK), technological pedagogical knowledge (TPK), and technological pedagogical content knowledge (TPACK). Figure 1 shows the different TPACK components.

- Content Knowledge (CK): refers to the knowledge of the content of the subject matter and its concepts, theories and facts.
- Pedagogical knowledge (PK): refers to the knowledge of teaching pedagogies, which include classroom management, student motivation, lesson planning, assessment, and knowledge of teaching methods, among others.
- Technological knowledge (TK): refers to the knowledge of different technologies used in educational contexts.
- Pedagogical content knowledge (PCK): refers to the knowledge of the best practices for teaching a certain subject matter. It goes beyond just knowing the content and the pedagogy to understanding the interplay between these components.
- Technological content knowledge (TCK): refers to the knowledge of how the available technologies and tools can enhance the content and how students will interact with it.
- Technological pedagogical knowledge (TPK): refers to the knowledge of how and what technology can do for specific pedagogical goals and selecting the most suitable technologies based on their appropriateness to meet a certain outcome.
- Technological pedagogical content knowledge (TPACK): refers to combining comprehensive content knowledge with the knowledge of choosing the most appropriate teaching method for a specific content to best accomplish the learning outcome while using the most suitable technology (Graham, 2011; Mishra & Koehler, 2006).

Figure 1 shows the different TPACK components (reproduced by permission of the publisher, © 2012 by tpack.org).

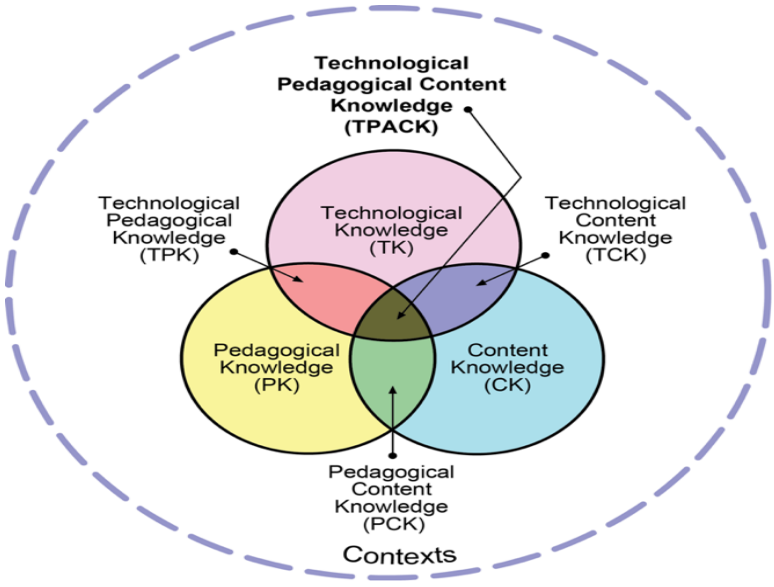

Figure 1. The seven components of the TPACK framework (http://tpack.org)

To better develop technology integration knowledge and skills, teacher education programs need to help pre-service teachers connect technological, pedagogical, and content knowledge (Mouza et al., 2017; Sun et al., 2017). Koehler and Mishra (2009) have also mentioned that effective technology integration requires that teachers be competent not only in these three knowledge components separately but also, and more importantly, in integrating them together (Schmidt et al., 2009).

2.3 Methods

The systematic review methodology was used to develop the theoretical framework of this present thesis. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol was implemented.

2.3.1 Research Questions

This systematic review answers the following questions:

1. What are the characteristics of the participants identified by the literature on the integration of technology in teacher education programs?
2. What are the methodologies incorporated in the literature on the integration of technology in teacher education programs?
3. What are the findings identified by the literature on the integration of technology in teacher education programs?
4. What are the challenges and recommendations identified by the literature on the integration of technology in teacher education programs?
5. What are the limitations and future suggestions identified by the literature on the integration of technology in teacher education programs?

2.3.2 Search Process

The database used for this search was the Web of Science (WOS) - Access Arts and Humanities Citation Index. The search terms used were: TOPIC: (TPACK) AND TOPIC: (Teacher Education) AND TOPIC: (Pre-service teacher*). As shown in figure 2 below, the preliminary search provided 149 results. As a second step, a 5-year time span (between 25/5/2016 and 25/5/2021) was added, limiting the output to 86 results. After that, the document type was restricted to articles, and this further narrowed the output to 75 results. As a final step, the Educational Research category was chosen to end the search with 67 articles. Out of these 67 articles, 21 were excluded based on the criteria mentioned below. Thus, the total number of articles that were included in this systematic review was 46.

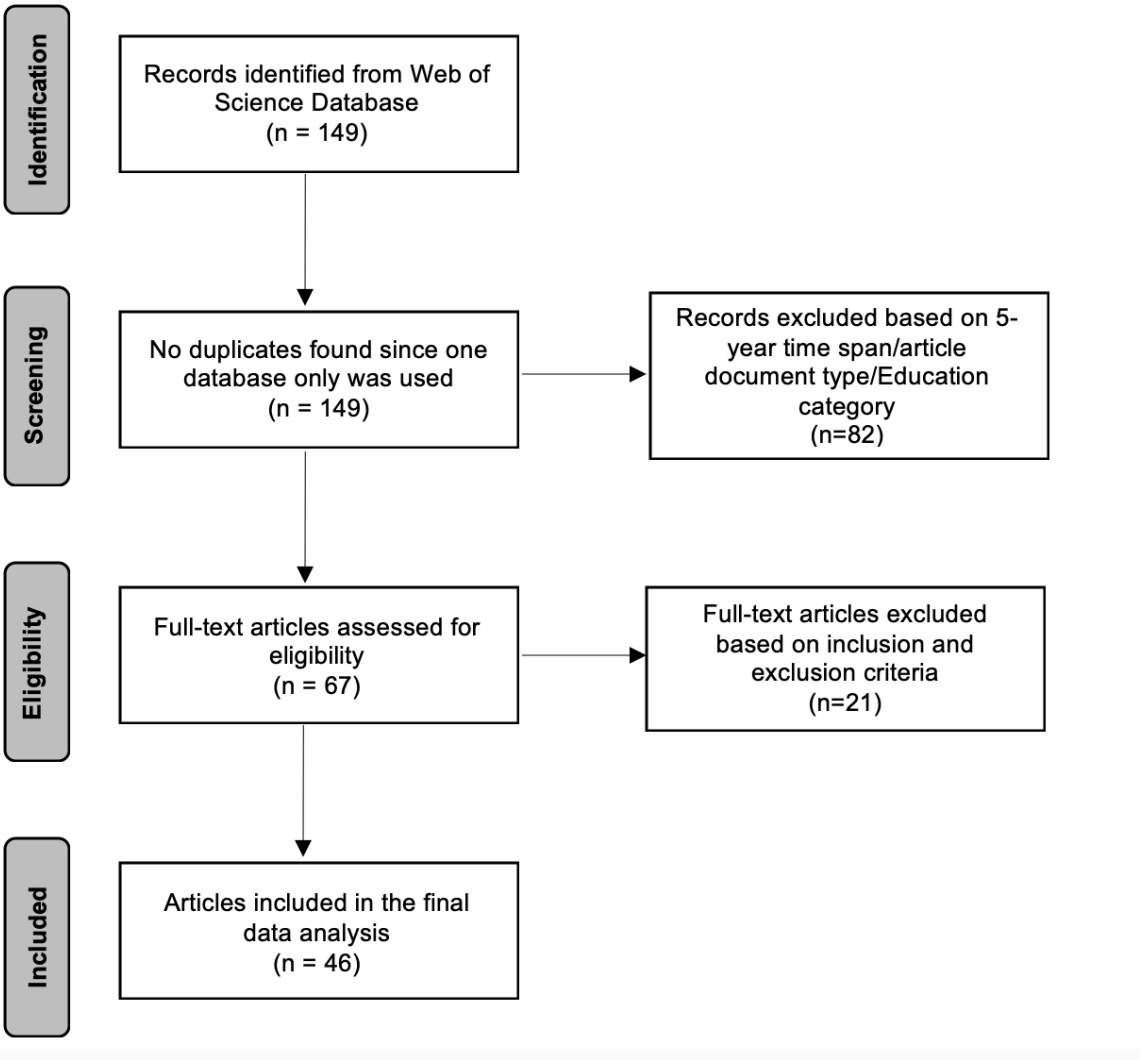

Figure 2. Results from the search and selection process (PRISMA flow diagram)

2.3.3 Inclusion and Exclusion Criteria

Below are the inclusion criteria that were determined for this systematic review:

- Peer-reviewed articles published between mid-2016 to mid-2021.
- Studies that assess the effectiveness of a certain approach, course, technology, or framework on TPACK development
- Studies that assess teachers' self-efficacy, self-confidence, motivation, satisfaction, perception, beliefs, and/or attitude towards TPACK and the integration of technology
- Studies that assess teacher education program's readiness and/or need to integrate technology in teaching
- Studies that identify the factors and/or skills that support and/or hinder teachers' technology integration in teaching
- Studies that examine the relationship between TPACK domains

The following exclusion criteria were determined for this systematic review. Studies that met any of these criteria were excluded:

- Studies that are not written in English
- Studies that are not published in a peer-reviewed journal
- Books, tutorials, dissertations, conference proceedings, poster publications and grey literature
- Studies that do not specifically address TPACK and/or technology integration
- Studies that assess or apply a certain approach or tool, irrespective of its TPACK implications
- Studies that only construct and/or validate a new or existing instrument to measure TPACK
- Comparative studies and meta-analysis

2.3.4 Data Collection and Extraction

After carrying out the search process and applying the inclusion and exclusion criteria, 46 articles were found relevant to answer the research questions of our systematic review. Several pieces of data were extracted from these articles:

- Study location
- Information about the participants (role, education level, gender, numbers)
- Research methodology and instruments used
- Study objectives, interventions, and results
- All the challenges addressed in the study
- All recommendations suggested in the study
- All the limitations mentioned in the study
- All recommendations concerning future studies

2.4 Results

The findings in this systematic review are presented following the study's research questions. They cover areas related to participants' characteristics, methodological designs, main results, challenges, recommendations, limitations, and future research.

As for the geographic distribution of the articles included in our systematic review, Turkey was the country with the highest number of studies (23.9%; n=11). It was followed by Australia and Spain, with each one of them having four articles and constituting 8.7% of the total studies (8.7%; n=4); Finland, the Netherlands, and the USA, with each of them having three articles and constituting 6.5% of the total articles (6.5%; n=3); Belgium, Malaysia, and South Africa, with each of them having two articles and constituting 4.3% of the total articles (4.3%; n=2); and China, Croatia, Estonia, Kuwait, Poland, Saudi Arabia, Singapore, Sweden, and Taiwan, with each one of them having one study and constituting 2.2% of the total studies (2.2%; n=1). Finally, there were three studies that were conducted across more than one country (6.5%; n=3). Figure 3 below shows the geographic distribution of the studied articles.

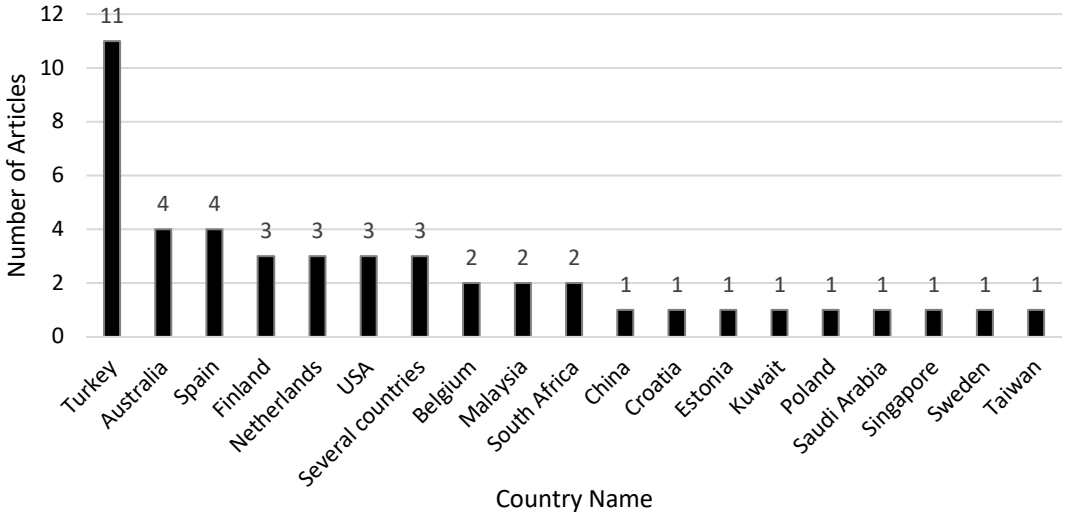

Figure 3. Geographic distribution of the studies

2.4.1 Participants' Characteristics

Participants' characteristics include their role, their academic degree level, their number and their gender distribution.

a. Participants' Role

The participants in the studied articles were of different roles: teacher educators, pre-service teachers, in-service teachers, school teachers, school students, and field experts. Most studies included pre-service teachers as the only participants (80.5%; n=37). Others included them in addition to teacher educators (4.3%; n=2) or in-service teachers (4.3%; n=2). One other study (2.2%; n=1) tried to approach the topic from a wider scope and thus included all the individuals pertinent to the teaching-learning process, like teacher educators, pre-service teachers, school teachers, and school students. Thus, the total number of articles that included pre-service teachers as participants in their study was 42. On the other hand, some studies have bypassed pre-service teachers and have solely studied teacher educators (4.3 %; n=2), in-service teachers (2.2%; n=1), or a group of experts (2.2%; n=1). The latter study differed from all other studies in that its authors followed the Delphi technique to transform the opinions of technology, language teaching, and early literacy experts into a group consensus about the skills and knowledge that should be taught in initial teacher education programs.

b. Participants' Academic Degree Level

As mentioned earlier, most studies included pre-service teachers as participants; however, these pre-service teachers were at different levels of their teacher education program. The majority were at the undergraduate level (45.2%; n=19) followed by graduate level (19%; n=8). Four studies (9.6%; n=4) involved students from mixed levels: undergraduate, and/or graduate,

and/or integrated BA and MA programs. The remaining eleven articles (26.2%; n=11) did not clearly specify the academic degree level of the pre-service participants.

c. Participants' Numbers

The highest number of pre-service participants was found in the mixed-level studies, with a mean of 297 pre-service teachers, followed by undergraduate-level studies (mean = 160) and then graduate-level studies (mean = 105). As for the papers that did not specify the participants' level, their mean was equal to 244 pre-service teachers. The lowest number of pre-service teacher participants in one study was 6 (Gill & Dalgarno, 2017; Gonzalez & Gonzalez-Ruiz, 2017; Tseng et al., 2019), and the highest was 807 (Xiong et al., 2020). This variation in the number of pre-service teachers was an advantage, as it helped in identifying the effectiveness of the intervention methods on small and large sample sizes. The mean of the in-service teacher participants was equal to 96. The lowest number of in-service teachers in one study was 1 (Tseng et al., 2019), and the highest was 211 (Saltan & Arslan, 2017). As for the mean of the teacher educator participants, it was equal to 7. The lowest number of teacher educators in one study was 3 (Tseng et al., 2019), and the highest was 12 (Voogt & McKenney, 2017). Concerning the school students who participated in one study (Tseng et al., 2019), their number was 14. Moreover, regarding the only study that included a group of experts (McKenney & Voogt, 2017), it ended up with 8 participants. Finally, one of the studies (Nasri et al., 2020) has not mentioned the number of participants.

d. Participants' (Pre-Service Teachers) Gender Distribution

Females composed the highest percentage of participants in all academic degree levels. There were an average of 66% female participants at the undergraduate level, 75% at the graduate level, and 86% at the mixed level. As for the studies that did not clearly state the level, the average of female participants was 76%. However, only two studies out of the 24 that mentioned the gender distribution had a higher percentage of male participants. For instance, the male participants of the first study (Merono et al., 2021) constituted 80% and were pursuing their Bachelor Degree in Physical Activity and Sport Sciences. This may explain the high percentage, as this major is usually recommended by males more than females. As for the males in the second study (Cetin-Dindar et al., 2018), they constituted 53% and were studying Chemistry Education.

2.4.2 Methodological Designs

The majority of the articles included in this systematic review have used quantitative methods for data collection (37%; n=17), followed by qualitative methods (35%, n=16) and mixed methods (28%; n=13). As for the tools and instruments, most articles have used questionnaires, surveys, forms, or scales (n=36), followed by interviews or focus groups (n=18), course artifacts (n=10), and finally reports and reflections (n=9). Some articles have adopted more than one instrument.

Table 1 below shows the detailed distribution of these tools among the studied articles based on their research methods.

Table 1. Detailed distribution of the research tools and instruments among the studied articles based on their research methods.

Data Collection Tool	Mixed Method	Quantitative	Qualitative
Questionnaire/Survey/form/scale			
Questionnaire/Survey/form/scale filled by pre-service teachers	11	17	4
Questionnaire/Survey/form/scale filled by teacher educators	1	-	-
Questionnaire/Survey/form/scale filled by in-service teachers	1	2	-
Questionnaire/Survey/form/scale filled by school students	1	-	-
Questionnaire/Survey/form/scale filled by experts	1	-	-
Observation form of teacher educators' classes filled by researchers	-	-	2
Interviews/Focus Groups			
Interview/focus group with pre-service teachers	6	-	7
Interview/focus group with teacher educators	1	-	3
Interview/focus group with in-service teachers	1	-	-
Interview/focus group with experts	1	-	-
Artefacts			
Course and students' artifacts	3	1	6
Reports/Reflections			
Pre-service teachers' reports/reflections	4	-	3
Teacher educators' reports/reflections	2	-	1
In-service teachers' reports/reflections	1	-	-

2.4.3 Articles' Main Results

The studies included in this review had several objectives. The most frequent ones were to assess the effectiveness of a certain approach on TPACK development (n=8) and to examine TPACK perceptions and confidence levels (n=8). Other objectives were to assess the effectiveness of a certain course on TPACK development (n=5), to assess the effectiveness of a certain technology on TPACK development (n=4), to assess the readiness of a certain teacher education program to prepare pre-service teachers to integrate technology in their future practices (n=4), to assess pre-service teachers' TPACK development throughout the teacher education program (n=2), and to study the factors that influence pre-service teachers' experience in integrating technology (n=2). Other objectives were mentioned once and aimed to assess the effectiveness of a certain framework, to examine the TPACK level of pre-service and in-service teachers, to evaluate the first impressions of pre-service teachers on TPACK based lessons, and to study the relationship between TPACK domains, the relationship between

preservice teachers' perception of TPACK and their academic achievement, the online teaching and learning experiences through the lens of TPACK, pre-service teachers' views on creating digital storybooks, the effects of faculty modeling of educational technology on pre-service teachers, and how several English language pre-service teachers enacted different forms of TPACK through design thinking, among others. A few articles have tackled more than one objective.

Out of the 46 articles included in this review, 25 (54%) have adopted intervention methods. The most frequently used applications in these interventions were Kahoot, Socrative, Padlet, and Prezi. Kahoot is a game-based learning platform used to create formative assessments, review students' knowledge, and design activities; Socrative is an interactive web-based student response system used to create polls and quizzes; Padlet is an online virtual bulletin board that allows both students and teachers to collaborate and share links, images, videos, and documents in a single place; and Prezi is a web-based tool used to create presentations using a map layout.

Concerning the remaining 21 articles, they mostly aimed at assessing the current perceptions, beliefs, or self-confidence levels of the participants concerning technology integration, so there was no need to implement any intervention method. Thus, the results will be provided in two subsections: the first for the studies that have adopted intervention methods and the second for those that have not.

a. Studies Adopting Intervention Methods

The intervention duration for these 25 studies ranged from 5 weeks to one year. Most interventions (60%; n=15) were implemented within a course timeframe, five (20%) between 5 to 14 weeks, one (4%) for around 6 months, and one (4%) for one year. The duration of the three remaining studies (12%) that have adopted intervention was not clearly stated.

As mentioned earlier, eight studies have aimed at assessing certain educational approaches. The results of these studies were very promising in regards to TPACK development and technology integration. An interesting outcome was that the technology-related components of the TPACK, mainly TK and TCK, were identified as the ones that showed the most significant improvement after the intervention (Asik et al., 2018; Saltan, 2017). TPK was also one of these components (Asik et al., 2018). However, integrating TK into TPK and TPACK was found to require more time, opportunities, and different types of tasks to develop (Bueno-Alastuey et al., 2018). Moreover, using the online case-based learning method did not lead to a significant improvement in pre-service teachers' TPACK self-confidence level (Saltan, 2017).

Teaching in authentic classrooms, peer-teaching, professional learning environments, more knowledgeable peers, group collaborations, mentor teachers' and teacher educators' roles and support, hands-on experience, use of digital tools, and technological capabilities were identified as factors that promoted teachers' TPACK and motivation to integrate technology.

Table 2 summarizes the interventions used to assess the effectiveness of several approaches and the results of these interventions.

Table 2. Summary of the interventions that were applied to assess the effectiveness of several educational approaches

Study	Approach	Intervention	Applications/Tools Used	Study Results
(Admiraal et al., 2017)	Technology-infused approach	In the first course, pre-service teachers were introduced to flipped learning and then had to prepare a lesson that is based on its principles and apply it in their classes. In the remaining sessions of the course, teacher educators made sure to integrate technology in their instruction and into the work of their students. In the second course, teacher educators explained several technology tools and clarified their usage explicitly. Pre-service teachers were then asked to choose one of these technology tools, apply it in their class, and then assess and evaluate it.	Video, audio, graphics, whiteboard, PowerPoint, Prezi, Blackboard, Socrative, Kahoot, Quizstar4teachers, Dutch drill-and-practice math program, Geogebra	1- Teaching practice or teaching in authentic classroom was very important to the development of pre-service teachers' technology integration knowledge and skills 2- Mentor teachers and teacher educators acted as role models and main motivators for pre-service teachers when it came to technology integration.
(Asik et al., 2018)	Learning technology by design approach	For two weeks, pre-service teachers were introduced to technology-related topics about language teaching with some sample activities. They were then given several digital tools to choose from and to prepare a presentation on the steps to be followed to design material based on this specific tool. They then had to invite one of their classmates (peer teaching) to try this tool (hands-on experience). They then received peer feedback about the digital tool they presented.	Storybird, Thinglink, H5P, Clarisketch, Word Cloud, Glogster, Plickers, Kahoot, My Storymaker, Voki, HP Reveal, Padlet, Penzu, Rewordify, Telescopic text, YouGlish, Listen & Write	1- The approach had a significant impact on pre-service teachers as it resulted in deeper learning 2- Peer teaching and hands-on experiences were very effective 3- The approach promoted pre-service teachers' TPACK especially their TK, TCK and TPK 4- Digital tools used increased pre-service teachers' motivation

(Bueno-Alastuey et al., 2018)	Virtual collaboration or telecollaboration	Pre-service teachers were from two different universities. First, every pre-service teacher had to fill out a questionnaire and then discuss it with the group members and justify the choices with the partners at the other university during a telecollaboration session. Second, they had to prepare a unit in which they integrate technology. They then had to send this unit to the corresponding group in the other university to analyze it. Then students had a second telecollaboration meeting to discuss the unit analysis. At the end, pre-service teachers had to write a reflection about their telecollaboration experience.	Skype, Debut Video Capture Software	1- This approach promoted collaboration, participation, and knowledge exchange and directed pre-service teachers to their TPACK 2- The integration of TK into TPK and TPACK needed more time, opportunities, and other types of tasks to develop
(Durak, 2021)	Using open-ended, authentic and hands-on learning activities	The 3 groups were introduced to several technologies and how to use them. Group 1 was assigned close-ended hands-on tasks; group 2 was assigned open-ended tasks; and group 3 was assigned authentic tasks.	Edmodo, Wordle, Wordart, Google Drive apps, Blogger, Prezi, Visme, Padlet, Kahoot, Socrative, StoryboardThat, Mindmeister, Aurasma HP Reveal, Quiver	1- Open-ended tasks led to an increase in technology use attitudes 2- Authentic tasks led to higher levels of motivation and satisfaction 3- Hands-on tasks led to higher technology integration self-efficacy
(Lee & James, 2018)	IDDIRR Model and PLC	In-service teachers attended a series of technology-integrated sessions that were based upon the Professional Learning Community PLC and the TPACK-IDDIRR Model. First, TPACK was **I**ntroduced and a TPACK-based lesson was **D**emonstrated. In-service teachers then had to **D**evelop their own TPACK-based lessons and *I*mplement them in their classrooms. Finally, they showcased their lessons and got **R**eflections from the other participants, and based on these reflections, they **R**evised their lessons.		1- This approach, along with the professional learning environment and the more knowledgeable peers, promoted in-service teachers' TPACK and encouraged them to integrate technology in teaching

(Meron o et al., 2021)	Cooperative learning	The study included one control group and two experimental groups. The approach implemented in the control group was the direct approach, and the tasks assigned were non-cooperative. As for the experimental groups, both followed the TPACK model; however, the first was based on a small-group work approach and the second on a cooperative learning approach.	Piktochart, Genially, Web of Science, Scopus	1- This approach, along with TPACK-based digital pedagogies, led to the development in pre-service teachers' TPACK and academic achievement
(Nguye n & Bower, 2018)	Collaborativ e design of technology-enhanced learning	Pre-service teachers were asked to work in groups to develop a Moodle-based course after attending a 90-minute hands-on tutor-guided overview of Moodle. They were also asked to provide a 600-word justification of the design they have created.	Moodle, Facebook, Google Docs	1- During their design tasks, pre-service teachers rarely mentioned anything about pedagogy 2- Tutor support, technological capabilities and group collaboration may either enhance or hinder the technology-based learning design process
(Saltan, 2017)	Online case-based learning method	The experimental group participated in online activities, unlike the control group. The experimental group had to watch 10 video-cases and investigate them using eight-step problem-solving approach	Webpage	1- There was no significant improvement in pre-service teachers' TPACK self-confidence level. 2- TK and TCK components improved significantly

In addition to the educational approaches, five courses were assessed as well. These courses also had a positive impact on pre-service teachers' beliefs, confidence, or efficacy to integrate technology in teaching. Again, TK, TCK and TPK were identified as the TPACK components that were most significantly developed (Durdu & Dag, 2017). PK and PCK were also identified by one study as the components that showed the most significant improvement (Cetin-Dindar et al., 2018).

Durdu and Dag (2017) found that pre-service teachers need to observe and practice instructional technology integration to develop their TK. This was supported by the pre-service teachers who participated in the study of Cindric and Greguric (2019), who mentioned that technology and content should be learned simultaneously and that technology integration made the course more interesting to them. These pre-service teachers also reported that teamwork and feedback sessions were very beneficial.

Table 3 summarizes the interventions used to assess the effectiveness of several courses and the results of these interventions.

Table 3. Summary of the interventions that were applied to assess the effectiveness of certain courses

Study	Course	Intervention	Applications/Tools Used	Study Results
(Cetin-Dindar et al., 2018)	Instructional Technology and Material Development (ITMD)	In this course, pre-service teachers learn how to integrate simulations, animations, instructional games, data logging, virtual labs, and virtual field trips into chemistry instruction.		1- The course improved pre-service teachers' PK and PCK significantly 2- The course improved pre-service teachers' confidence to integrate technology in teaching 3- Pre-service teachers were able to recognize the power of technology
(Chai et al., 2017)	ICT for Meaningful Learning	Experiencing meaningful learning and learning by design were the main principles implemented in this course. During this course, students discussed topics related to technology integration in collaborative and self-directed learning and were introduced to several technologies that would help in solving authentic problems. At the end, students had to design lessons that trigger meaningful learning among students.		1- The course improved pre-service teachers' TPACK efficacy and beliefs and their design capacities
(Cindric & Greguric, 2019)	Creative Teaching Activities 2: Picture Books and Storytelling	During the course, students were introduced to topics and were assigned tasks related to oral production, speaking, and storytelling. After that, they were introduced to the sound editing software, Audacity, and were then assigned tasks on it. They also received feedback on these tasks. In the final project, students had to prepare a screenplay in groups, and then they had to record it as audio drama. They then presented their final project and got feedback about it.	Audacity	1- The course helped pre-service teachers acquire and integrate technology in the assigned tasks 2- Pre-service teachers mentioned that technology and content should be learned simultaneously and that technology integration made the course more interesting 3- Pre-service teachers reported that they benefited from the

				teamwork and feedback sessions
(Durdu & Dag, 2017)	Computer-Based Mathematics	During this course, students were introduced to instructional technology and implementing it in educational settings, teaching and learning using technology, mathematics education using technology, and were also exposed to GeoGebra software.	GeoGebra	1- The course improved pre-service teachers' TPACK especially the TK, TCK and TPK components 2- To develop their TK, pre-service teachers need to observe and practice instructional technology integration
(Kapici & Akcay, 2020)	Laboratory Applications in Science Teaching	During this course, pre-service teachers were introduced to TPACK, the inquiry-based learning cycle, and the Inquiry Learning Space (ILS). The teacher educator then prepared a sample lesson plan, and pre-service teachers were then asked to design inquiry-based, technology-enhanced lesson plans.	Inquiry Learning Space (ILS) learning environment	1- The course improved pre-service teachers' TPACK self-efficacy

As for the technologies that were assessed, they all led to a development in pre-service teachers' TPACK. TK and TPK were once again mentioned as the components that showed the most significant improvement (Rets et al., 2020). It was also found that there was a positive relationship between pre-service teachers' prior knowledge of technology and the level of their concern about using it in teaching.

Table 4 summarizes the interventions used to assess the effectiveness of several technologies and the results of these interventions.

Table 4. Summary of the interventions that were applied to assess the effectiveness of certain technologies

Study	Technology	Intervention	Applications/ Tools Used	Study Results
(Akay, 2017)	Ob-Videos (Objective-based videos)	These are videos that are developed based on the objectives stated in the curriculum. The teacher educator explained how to develop ob-videos and highlighted the importance of mobile phones in teaching and learning. Pre-service teachers were then asked to choose a topic and an objective and create an ob-video about it. They took in and out of class footage and added captions, subtitles, and voice-overs to their videos. In the next step, pre-service teachers presented their videos to their classmates and received their feedback.	Computer, projector, ob-video, mobile phone	1- The technology had a positive effect on pre-service teachers, and it helped them integrate technology with content and pedagogy
(Oakley, 2020)	Digital Storybooks	Pre-service teachers were introduced to the TPACK framework and were then asked to create a digital storybook and use it in their first professional practice. The aim of this assignment was to help pre-service teachers teach specific literacy concepts to children (4 to 8 years old). Pre-service teachers were also asked to write a rationale about the design of their digital storybooks.	Digital Storybooks	1- Using this technology has developed pre-service teachers' TPACK in teaching literacy for early years 2- Pre-service teachers found this technology engaging
(Rets et al., 2020)	VE (Virtual Exchange)	This study focused on 2 VEs. The first VE members had to prepare individual videos and post them on Moodle, explore an educational topic, and prepare a presentation collaboratively. The second VE members had to exchange information and resources within their classroom-based program, compare and analyze cultural practices, and prepare a lesson plan collaboratively.	VE (Virtual Exchange), Moodle	1- This technology developed pre-service teachers' TPACK, especially the TK and the TPK components 2- There was a positive relationship between pre-service teachers' prior knowledge of technology and the level of their concern at using it in teaching

(Rienties et al., 2020)	VE (Virtual Exchange)	Participants engaged in intensive VE with partner classes in institutions in other countries based on specifically designed tasks related to digital-pedagogical competences as well as intercultural competence.	VE (Virtual Exchange)	1- The technology helped pre-service teachers to gradually gain confidence in their TPACK skills and made them more aware of how they could potentially use technology in their future teaching

Several noteworthy results were obtained from the eight remaining studies that adopted intervention methods and targeted different objectives. The Digital Competence of Educators Framework was helpful in increasing pre-service teachers' confidence in technology integration, yet PK and PCK showed less significant progress compared to the other TPACK components (Miguel-Revilla et al., 2020). This contradicts the results of the study that assessed the effectiveness of the Instructional Technology and Material Development course and that concluded that PK and PCK were the components that showed the most significant development (Cetin-Dindar et al., 2018). One of the studies that examined the factors that may affect pre-service teachers' technology integration concluded that without the acquisition of solid PK and PCK, it would be difficult to expect pre-service teachers to develop TPACK (Jones et al., 2017). Another study has found that TK, PK, and CK were not predictors of TPACK. This means that trying to develop pre-service teachers' TK, PK, and CK independently does not guarantee TPACK development (Kaplon-Schilis & Lyublinskay, 2020).

Pre-service teachers' impressions towards TPACK-based lessons were very positive. For instance, pre-service teachers have mentioned that such lessons have attracted their attention and made them more actively engaged.

As for in-service teachers, it was found that they needed support in some TPACK components and that they had fewer chances to practice TPACK compared to pre-service teachers. This was due to the limited technological resources provided at the schools where they teach. Attending a TPACK-based workshop was very effective in providing in-service teachers with rich examples on how to integrate technology (Alrwaished et al., 2017). Also, teacher educators may lack some TPACK components; thus they, too, need to develop their skills in matching technological tools and pedagogical practices (Nasri et al., 2020).

Again, the support of the mentor teachers was found to be an important factor that influences pre-service teachers' experience in technology integration (Jones et al., 2017). Another factor was teacher educators' modeling, which encouraged pre-service teachers to integrate technology, yet it did not influence their self-reported comfort level in this aspect (Zipke et al., 2019).

Table 5 summarizes the interventions used to assess different objectives and the results of these interventions.

Table 5. Summary of the interventions that were applied to assess the other objectives

Study	Objective	Intervention	Applications/Tools Used	Study Results
(Miguel-Revilla et al., 2020)	Assess the effectiveness of the Digital Competence of Educators Framework	The course was based on project-based learning, and pre-service teachers were grouped into small teams. They had to conceptualize, design, and implement an online platform project within the framework of the course.		1- Pre-service teachers' confidence in integrating technology with content and pedagogy increased 2- PK and PCK components showed less significant progress
(Alrwais hed et al., 2017)	To examine the TPACK level of pre-service and in-service teachers	In-service teachers who scored low on their self-assessment of TPACK components were invited to participate in a workshop. In this workshop, they were introduced to TPACK and trained on how to integrate TPACK in their mathematics and science lessons. They also had to develop lessons based on TPACK. 2- Pre-service teachers filled a questionnaire after exposure to two technology courses		1- In-service teachers needed some support in some aspects of TPACK, and this was provided by the TPACK workshop they attended 2- Pre-service teachers had more opportunities to practice TPACK than in-service teachers 3- In-service science teachers did significantly better than in-service mathematics teachers on TPACK, TCK, and TPK
(Cam & Koc, 2021)	To evaluate the first impressions of pre-service teachers on the TPACK-based lessons that were delivered by their teacher educators who had previously undergone TPACK training sessions	Teacher educators underwent a TPACK training program. In the first stage of this training, teacher educators were introduced to the nature of TPACK. In the second stage, they were provided with technology integration training, introduced to 14 technological applications, and had discussions about how to use these applications in teaching. In the last stage, teacher educators had to choose one technological application and prepare a lesson plan. They then had to apply this lesson in real classrooms.	Google Drive, EDMODO, Xmind-ImindMap-Gliffy, TAGUL, Prezi, Emaze, Kahoot, Socrative, Poll Everywhere, Google Form, Padlet, Camtasia Studio, Powtoon, Hangouts	1- Pre-service teachers had a positive attitude towards the TPACK-based lessons that were delivered 2- TPACK practices attracted the attention of pre-service teachers and made them more actively engaged in the lesson

(Jones et al., 2017)	To study the factors that influence pre-service teachers' experience in integrating technology	Pre-service teachers had to spend a seven-week field placement at a school and, meanwhile, attend a seminar taught by a faculty member who modeled how to integrate technology within PE settings. Pre-service teachers were also asked to prepare an action research project (ARP) in which they had to integrate pre-assigned technology into an instructional unit.		1- PK and TPACK played an effective role in technology integration 2- The cooperating teachers' support was found to be important 3- Without the acquisition of solid PK and PCK, it would be difficult to expect pre-service teachers to develop TPACK 4- A single technology course focusing on technology integration in PE had a positive impact on pre-service teachers' knowledge regarding technology integration
(Kaplon-Schilis & Lyublinskay, 2020)	To study the relationship between TPACK domains	In a course about integrating technology, pre-service teachers were introduced to traditional and emerging instructional technologies and were taught how to use several digital tools. They were also taught how to use technology to differentiate instruction, assess students' learning, and adapt instruction. Pre-service teachers then used specific instructional technology tools to develop activities and prepare and deliver lesson plans.	Microsoft office, SMART Board, SMART Notebook, Geometer's Sketchpad, Data Collection-sensors/probes with various interfaces and platforms, calculators, Web 2.0 tools such as blogs, etc.	1- TK, PK, and CK were not predictors of TPACK. The independent development of pre-service teachers' TK, PK, and CK does not guarantee the development of their TPACK
(Nasri et al., 2020)	To study the online teaching and learning experiences through the lens of TPACK and online learning models	Training sessions were conducted by ICT lecturers to help teacher educators develop teaching materials and get acquainted with online platforms	Zoom, Microsoft Teams	1- Pre-service teachers had issues with online collaborative learning (possibly due to lack of elements of TPACK on behalf of the teacher educator providing the courses) 2- Teacher educators need to develop their expertise in matching technological tools and pedagogical practices

(Tseng et al., 2019)	To study how several English language pre-service teachers enacted different forms of TPACK through design thinking based on web-conferencing teaching and the problems they faced	Before the intervention, pre-service teachers were trained by teacher educators on how to design the curriculum and the teaching material and how to operate the web-conferencing platform. Design thinking was implemented in the study's web conferencing teaching. The steps that were followed are: First, one pre-service teacher designed the teaching materials. Second, all pre-service teachers implemented distance teaching using the same online materials. Third, pre-service teachers discussed problems encountered and reflected on the materials and practices, and finally, they adjusted their teaching and redesigned their teaching materials and activities.	Adobe Connect, PowerPoint, whiteboards, text chat	1- Teachers' discussions clearly displayed an orientation towards PCK and were not related to TPK 2- When teachers build TPK, they need to develop a deeper understanding of the technological advantages, limits, and best usages in different contexts
(Zipke et al., 2019)	To study the effects of faculty modeling of educational technology on pre-service teachers' self-efficacy attitudes	The investigators modeled the use of instructional educational technology throughout the semester and then required participants to produce course work in which students wrote about their perceptions of and experiences with educational technology.	Kahoot, Edpuzzle, Nearpod, LMS, Remind, YouCanBookMe, Google Docs, Onenote	1- Modeling by the teacher educators helped encourage the use of technology. Pre-service teachers' enthusiasm about educational technology grew once they saw it in action 2- Pre-service teachers' self-reported comfort level in integrating technology into their teaching did not change significantly from the beginning of the semester to the end of the semester

b. Studies Not Adopting Intervention Methods

Twenty-one articles have not adopted intervention methods. Four of them have assessed the readiness of teacher education programs to prepare pre-service teachers to integrate technology into their future practices. These studies were conducted in Saudi Arabia, Sweden, Belgium, and the Netherlands. The results have reflected that the teacher education programs that were studied have not adequately or sufficiently prepared pre-service teachers to integrate technology in their educational practices. Voogt and McKenney (2017) have added that teacher educators themselves struggle in their own courses to effectively integrate technology. They are still using technology in a traditional teacher-centered approach and are not implementing

any learning theory or technology integration framework in their teaching. What makes things more complicated is that educational institutions do not have clear policies that mandate the adoption of recent theories and frameworks (Tunjera & Chigona, 2020).

As for pre-service teachers, they had positive perceptions towards TPACK (Farjon et al., 2019; Isler & Yildirim, 2018; Redmond & Lock, 2019). First-year pre-service teachers were mostly confident in the PK area and least confident in the TCK area (Valtonen et al., 2018). They identified TPK, followed by PK, as the most challenging TPACK components (Valtonen et al., 2020). Saltan and Arslan (2017), who included participants from different levels of the teacher education program, have reported that pre-service and in-service teachers have shown the highest level of self-confidence in the TCK domain. As for the component with the lowest self-confidence level, it was the TPACK for pre-service teachers and the TK for in-service teachers. They have found that the TK component varies with one's experience. To illustrate, teachers with 6 to 15 years of teaching experience scored higher on TK compared to those with 20 years of teaching experience. These results were supported by another study that included undergraduate and graduate-level pre-service teachers and concluded that there was a statistically significant negative relationship between age and technology. It also concluded that there was a positive relationship between age and content; however, pedagogy was not significantly related to age. The same study has indicated that pre-service teachers lack PK, but they believe that they are good at technology integration and that the perceptions of graduate pre-service teachers are higher compared to undergraduate ones. Graduate-level pre-service teachers perceived TK and CK higher than PK, while the undergraduate ones perceived TK higher than PK and CK (Luik et al., 2018). Moreover, in a study that took three measurement points over the three-year teacher education program, PK and TPK showed the highest gains, and TK and CK showed the smallest gains. TCK was identified as the lowest TPACK area (Valtonen et al., 2019). These results highlight the central role of PK in developing pre-service teachers' TPACK. As for their self-confidence regarding educational technology, it was reported that it will develop with the use of more instructional tools (Karatas et al. 2017). Another study has stressed the effect of some undergraduate courses on improving pre-service teachers' self-confidence in using technology. This inference was made after comparing the low scores of freshman pre-service teachers to the senior ones (Karatas et al., 2017).

Concerning gender and perceptions towards technology, one study has found that males had higher perceptions than females, but the difference is insignificant when it comes to pedagogy (Luik et al., 2018). In contrast, another study has found that females had higher perceptions towards technology, but males had higher TPACK and TPACK self-confidence (Karatas et al., 2017).

In one study, science pre-service teachers had a higher TPACK when compared to mathematics pre-service teachers. Also, the ICT in-service teachers had a significantly higher TPACK level when compared to their science, mathematics, and classroom counterparts. However, the TCK did not differ significantly based on the subject matter (Saltan & Arslan, 2017).

Pre-service teachers who had high scores on TPACK, attitudes, and self-efficacy reported that they had received good support at the teacher education program (Tondeur et al., 2017). Pre-service teachers also reported that their TPACK understanding and practice will develop during their course work and professional placements (Redmond & Lock, 2019). They believe that integrating technology in teaching makes the learning process more interesting, engaging, and collaborative and promotes individualized learning (Isler & Yildirim, 2018).

The school culture and technology resources, technology integration practice and modeling by the mentor teacher and teacher educators, and the course assignments are the main factors that were mentioned by Gill and Dalgarno (2017) and that affect pre-service teachers' TPACK development. Tiba and Condy (2021) have also identified technology integration modeling by the teacher educators and the mentor teacher and have added other factors like technology-related projects and workshops and the availability of technology resources and IT personnel at the institution who can provide support to teacher educators.

2.4.4 Challenges

Twenty-one articles out of 46 have identified the challenges to integrate technology into the teaching-learning process. These challenges were classified into five categories. The category that was mentioned by the highest number of articles was about the challenges related to technology (n=14), and it was followed by that related to pre-service teachers (n=8), teacher education programs (n=6), teacher educators (n=5), and mentor teachers (n=5). Some articles have identified more than one challenge.

a. Technology-Related Challenges

The technology-related challenges mentioned could be summed up by the limited internet access (Alrwaished et al., 2017; Cam & Koc, 2021; Durak, 2021; Isler & Yildirim, 2018; Nasri et al., 2020), the lack of hardware and equipment (Cam & Koc, 2021; Isler & Yildirim, 2018; Tiba & Condy, 2021; Zipke et al., 2019), and the inadequate technology resources (Tunjera & Chigona, 2020), mainly at the schools (Oakley, 2020) where pre-service teachers had to do their field placement. Teacher educators have also faced some technical challenges related to the lack of technical support, the lack of relevant professional development in this regard (Tunjera & Chigona, 2020), and the limited availability of content-specific technologies compared with more general-level technologies and software (Valtonen et al., 2019). There were also some general technology problems (Admiraal et al., 2017; Rets et al., 2020; Tseng et al., 2019; Valtonen et al., 2020).

b. Pre-Service Teachers-Related Challenges

The challenges faced at the pre-service level were mostly pedagogical. For instance, during their field placement at schools, pre-service teachers had difficulties in managing their classes especially when technology is integrated (Admiraal et al., 2017; Cam & Koc, 2021; Valtonen et al., 2020), determining the literacy learning needs and the relevant learning goals of their

students (Oakley, 2020), designing technology-based learning material (Durak, 2021), choosing and designing tasks that would keep their students highly motivated, providing appropriate feedback, recognizing their students' skills and readiness to use ICT, supporting their students with their ICT work and controlling the lessons so that computers are to be used for the right purposes and not for gaming (Valtonen et al., 2020).

Pre-service teachers have also faced problems when working on technology-based projects. To illustrate, some pre-service teachers' TPACK competence was below the desired level (Akay, 2017), and some had anxiety while using technology (Rets et al., 2020). Other pre-service teachers preferred to develop hands-on materials instead of technology-based ones (Akay, 2017), and others faced breakdowns in collaboration when assigned group work (Nguyen & Bower, 2018). For example, they showed limited capacity to communicate properly, accept different points of view, distribute the group workload fairly among group members, and finally meet due dates.

c. Teacher Education Program-Related Challenges

The challenges identified at the teacher education level were related to courses, workshops, curriculum, and projects' design. To start with, some teacher education programs did not include educational technology compulsory courses (Masoumi, 2021), or there were very few courses or learning opportunities that would help pre-service teachers develop technology integration knowledge (Voogt & McKenney, 2017). What made things even harder is that designing TPACK-based courses is very time-consuming (Cetin-Dindar et al., 2018). As for some workshops that were provided on campus by the teacher education institutes, their duration was too short, and their main focus was on technology proficiency and not on how to teach the content using the most effective pedagogical technologies and methods. Thus, these workshops were not sufficient to upskill pre-service teachers to effectively integrate technology into teaching (Tiba & Condy, 2021). Moreover, some curricula in some countries have limited room for technology integration due to time constraints. Pre-service teachers in these countries need to be well-prepared for the national assessment; thus, the concentration is on the content rather than on technology integration (Voogt & McKenney, 2017). Finally, some projects assigned during the teacher education program were very time-consuming (Oakley, 2020), as pre-service teachers had to learn too many tools to design a project and were thus overloaded (Nguyen & Bower, 2018).

d. Teacher Educators-Related Challenges

Several challenges were identified at the teacher educator level. Some teacher educators lacked the TPACK knowledge required to set up a learning environment that is rich in technology (Masoumi, 2021). They lacked technology competencies that would allow them to integrate technology into their subject matters and become pre-service teachers' role models in this aspect (Tondeur et al., 2020; Voogt & McKenney, 2017). Thus, they failed to provide pre-service teachers with specific explanations, examples, and guidance on how to practically

integrate technology in teaching (Isler & Yildirim, 2018). On the other hand, other teacher educators who had access to several technologies and methods did not make full use of them due to the lack of time, technological support, and self-confidence in using the available technologies (Masoumi, 2021). Other challenges were related to not providing pre-service teachers with project-based technological tasks and not granting them more grades for using technology in their school field placements (Tiba & Condy, 2021). This has demotivated and discouraged pre-service teachers from using technology in teaching and learning, as they find it a time-consuming process to prepare technology-based material.

e. Mentor Teachers-Related Challenges

Field placements at schools are usually an excellent opportunity for pre-service teachers to examine technology integration in practice. However, some mentor teachers or cooperating teachers lack technology use and experience (Jones et al., 2017). They do not use or model technology integration in their educational practices (Masoumi, 2021; Oakley, 2020). Thus, this will deprive pre-service teachers of subject-related technology experience. Moreover, some mentor teachers made limited interaction with pre-service teachers (Oakley, 2020) and did not encourage them to use technology during their field placement (Isler & Yildirim, 2018). Also, some mentor teacher teachers did not provide extra grades for pre-service teachers when they used technology in teaching, and this was demotivating for them (Tiba & Condy, 2021).

2.4.5 Recommendations

The recommendations that were provided by the articles included in this review were divided into six categories. The category that was mentioned by the highest number of articles was about the recommendations related to teacher education programs (n=19), and it was followed by that related to professional development workshops and trainings (n=10), teacher educators (n=9), field placements at schools (n=8), technical issues (n=4), and pre-service teachers (n=1).

a. Recommendations Related to Teacher Education Program

Tunjera and Chigona (2020) have recommended that policy makers at teacher education programs embrace technology integration frameworks, while Al-Abdullatif (2019) has specified TPACK as a model to be used to reform such programs by integrating technology in the teaching and learning process. The TPACK model was recommended to be adopted for online learning as well (Nasri et al., 2020). For a successful integration, technology needs to be systematically infused all through the teacher education program (Durdu & Dag, 2017; Masoumi, 2021; Tondeur et al., 2017), and it should also be part of the evaluation criteria (Saltan & Arslan, 2017) and practice teaching (Cetin-Dindar et al., 2018). Thus, more digital technology obligatory courses should be introduced in the curriculum (Masoumi, 2021), and as for the existing ones, their quality should be revised (Durak, 2021; Nasri et al., 2020). For instance, Cindric and Greguric (2019) have suggested revisiting the curriculum to free pre-service teachers from the workload of redundant and irrelevant content, while Tomczyk (2020) has suggested this revisit be made to improve pre-service teachers' digital literacy perception

and attitude. Courses should be designed to emphasize peer collaboration and reflection (Asik et al., 2018), as well as critical thinking, problem solving, collaboration, and creativity (Miguel-Revilla et al., 2020).

It was also recommended to revisit the pedagogical methods and materials adopted in the teacher education programs (Cam & Koc, 2021). These programs should provide pre-service teachers with more exemplary TPACK-based lessons (Tondeur et al., 2020) and first-hand experiences and chances to integrate technology in teaching (Masoumi, 2021). They should also expose them to instructional technological tools and software (Kapici & Akcay, 2020; Karatas et al., 2017). McKenney and Voogt (2017) have mentioned that pre-service teachers need to be taught the less common tools and applications and how to use them effectively. Not only this, it was recommended that pre-service teachers design TPACK-based instructional materials (Tondeur et al., 2020) and activities themselves, as this will help them gain confidence in technology integration (Karatas et al., 2017). Durdu and Dag (2017) have added that pre-service teachers also need to apply the material and tools they designed into their micro-teaching sessions. Moreover, more attention should be devoted to developing pre-service teachers' ability to identify the most suitable tools and applications that align with the intended learning outcomes and the various forms of interaction (groups, pairs, etc.) that can go with every technology (McKenney & Voogt, 2017). As for the tasks and activities assigned to novice pre-service teachers, they should be authentic and should help them base their design on pedagogy and make the best choice of technology usage (Nguyen & Bower, 2018). Finally, Tunjera and Chigona (2020) have suggested that teacher education programs involve more faculty members who are specialists in educational technology and have good knowledge and background in learning theories.

b. Recommendations Related to Professional Development Workshops/Trainings

Five articles have recommended professional development workshops and trainings for teacher educators to provide them with the required skills needed to effectively teach with technology, as they act as role models to their students in this aspect (Cam & Koc, 2021; Tiba & Condy, 2021; Tondeur et al., 2020; Tunjera & Chigona, 2020; Voogt & McKenney, 2017). Tiba and Condy (2021) have added that these trainings should concentrate on authentic and hands-on tasks, whereas Tunjera and Chigona (2020) have recommended these workshops be discipline-specific on transformative technology-mediated interventions.

Cam and Koc (2021) have also recommended professional development workshops and trainings for pre-service and/or in-service teachers as well. Four other articles have made the same recommendation (Akay, 2017; Alrwaished et al., 2017; Redmond & Lock, 2019; Saltan & Arslan, 2017).

Lee and James (2018) have recommended using online platforms for professional development sessions and avoiding limiting them to face-to-face ones, as this will motivate teachers to practice technology integration and will alter their mindset concerning 21st century teaching.

c. Recommendations Related to Teacher Educators

Four articles (Durdu & Dag, 2017; Gill & Dalgarno, 2017; Isler & Yildirim, 2018; Redmond & Lock, 2019) have recommended that teacher educators act as role models to pre-service teachers by providing them with hands-on experience on integrating technology in instruction. Teacher educators were also encouraged to promote their technological pedagogical knowledge (Masoumi, 2021) and increase their use of technology in order to improve their students' TPACK (Zipke et al., 2019). They were also required to develop their abilities in matching technology-based tools with pedagogical approaches (Nasri et al., 2020). In addition, teacher educators also have a role in encouraging pre-service teachers to use pedagogical reasoning while designing their learning resources (Nguyen & Bower, 2018). They should also encourage pre-service teachers who have high confidence in integrating technology to further develop this area and to support their colleagues with lower confidence. Finally, Voogt and McKenney (2017) have recommended the support of teacher educators with a technology specialty to their colleagues in the early literacy specialty who lack technology competencies. This support aims at enabling early literacy teacher educators to enhance their curriculum with technology.

d. Recommendations Related to Field Placements at Schools

Eight articles have provided recommendations related to field placements at schools. These recommendations were classified by the authors into four sub-categories: training courses, placement environment, pre-service teachers' role, and mentor teachers as role models.

To start with, it was recommended to provide pre-service teachers with a technology integration course prior to and during their field placement. Such a course will help pre-service teachers get acquainted with technology integration in teaching and will consequently reduce any negative attitude that may arise due to the lack of prior exposure to such approaches (Jones et al., 2017).

As for the placement environment, two articles have recommended placing pre-service teachers at schools that have the proper ICT resources and that effectively integrate technology in teaching (Gill & Dalgarno, 2017; Masoumi, 2021). However, Tiba and Condy (2021) have recommended that this placement be in resourced and non-resourced schools so that pre-service teachers could have equal opportunities and experience in using technology. The last recommendation in this regard was limited to the Netherlands and was about making more placements at secondary schools. This is due to the fact that such schools are better equipped with subject-related hardware and software that would facilitate students' understanding of the subject matter. In this way, pre-service teachers will get exposed to these technologies and will gain better experience in technology integration (Admiraal et al., 2017).

Pre-service teachers' role should also be considered during field placements (Jones et al., 2017). Gill and Dalgarno (2017) recommended that pre-service teachers handle all the teaching for a complete term. Masoumi (2021) has suggested providing pre-service teachers with the

opportunity to implement the ICT they acquired in their teacher education program during their field placement. Moreover, Isler and Yildirim (2018) have mentioned that pre-service teachers should have the chance to design and use technology-based teaching material during their placement teaching.

Finally, three articles (Gill & Dalgarno, 2017; Jones et al., 2017; Zipke et al., 2019) have stressed the importance of placing pre-service teachers in the classes of quality mentors who model and integrate technology in teaching, as this will develop pre-service teachers' TPACK. Moreover, Redmond and Lock (2019) have suggested that ongoing professional conversations about TPACK and technology integration be held between pre-service teachers and mentor teachers.

e. Recommendations Related to Technical Issues

A limited number of recommendations related to technical issues have been mentioned in the reviewed articles. Four articles have provided four different recommendations. Cam and Koc (2021) have stated that bigger efforts are needed to provide both schools and universities with proper technology-related equipment and internet access. Other authors (Cetin-Dindar et al., 2018) have recommended integrating more technology-related applications in the teaching and learning process. These applications include those designed by field experts or those available online. Tunjera and Chigona (2020) have added that it is not enough to provide schools and universities with all the technological resources. There should frequent maintenance and upgrades to all these resources. The last recommendation was to provide the proper technology-related infrastructure and support to all individuals involved in the teaching and learning process (Nasri et al., 2020).

f. Recommendations Related to Pre-service Teachers

Only one study (Redmond & Lock, 2019) has provided recommendations to integrate technology related to pre-service teachers. The authors have stressed the point that pre-service teachers need to be open and have the will to use pedagogical approaches to integrate technology, as this will help them attain deeper learning of the content. They also need to follow the TPACK model in their future teaching, as practicing it will help them better understand its components.

2.4.6 Limitations

The limitations mentioned in the studied articles were related to the participants (n=15), research methods and tools (n=10), contexts, disciplines, and courses (n=8), study duration (n=5), and technologies and digital tools (n=2). Other limitations included contextual and cultural biases (McKenney & Voogt, 2017), lacking technology in the field placement schools (Zipke et al., 2019), and not investigating pre-service teachers' TPK, PCK, TCK, and thoughts about the new culture of learning (Chai et al., 2017).

a. Participants

The limitation that was mentioned the most under this category (n=6) was related to the limited sample size (Cetin-Dindar et al., 2018; Kaplon-Schilis & Lyublinskay, 2020; Miguel-Revilla et al., 2020; Oakley, 2020; Redmond & Lock, 2019; Tseng et al., 2019).

Another limitation was due to the voluntary participation in the study, which made enthusiastic participants with intrinsic motivation take part (Lee & James, 2018; Rienties et al., 2020; Voogt & McKenney, 2017), and this may have positively influenced the results. Also, including participants who welcome new ideas and excluding those who are resistant to change was another limitation (Lee & James, 2018).

Other studies have mentioned other limitations like the natural study sample (Merono et al., 2021), the specificity of the population (Kaplon-Schilis & Lyublinskay, 2020), the predominance of female participants (Karatas et al., 2017) or certain ethnic minorities (Xiong et al., 2020), respondent attrition (McKenney & Voogt, 2017), not introducing the participating pre-service teachers to the TPACK framework (Chai et al., 2017), limiting the study to novice pre-service teachers (Tseng et al., 2019), studying pre-service teachers who were at their first semester of the study program (Oakley, 2020), and finally studying preservice teachers with different academic backgrounds and majors (Luik et al., 2018).

b. Research Methods and Tools

The most frequently mentioned limitation (n=7) under this category was related to the self-report nature of the instruments used in the studies (Luik et al., 2018; Oakley, 2020; Rets et al., 2020; Rienties et al., 2020; Tondeur et al., 2020; Valtonen et al., 2019; Zipke et al., 2019). The main disadvantage of this point is that participants may either underestimate or overestimate their abilities. Depending solely on quantitative tools was another limitation (Karatas et al., 2017; Xiong et al., 2020). Other limitations were related to the absence of triangulation methods (Zipke et al., 2019), not including pre-service teachers' microteaching observation as a measurement tool (Kapici & Akcay, 2020), and the wording of the survey and its questions that have not targeted TPACK directly (Oakley, 2020).

c. Contexts, Disciplines and Courses

Three studies have mentioned that the small number of universities that were included in the study was a major limitation that would prohibit generalizing the results (Cetin-Dindar et al., 2018; Redmond & Lock, 2019; Voogt & McKenney, 2017). For instance, Tunjera and Chigona (2020) have mentioned that choosing teacher educator participants from the same institution was a limitation in their study. Another limitation that would prohibit generalizing the results to other contexts was related to the limited number and specificity of the courses included in the study (Admiraal et al., 2017; Durdu & Dag, 2017; Miguel-Revilla et al., 2020; Redmond & Lock, 2019). For example, McKenney and Voogt (2017) have mentioned that one

of their study limitations was that their findings may not be applicable in contexts that do not speak Dutch.

Another limitation was about the other educational courses that pre-service teachers were taking alongside the intervention course and which could have an influence on the study results (Cetin-Dindar et al., 2018).

d. Study Duration

Four studies have stated the short duration of the study as a major limitation (Cam & Koc, 2021; Durdu & Dag, 2017; Rienties et al., 2020; Saltan, 2017). Another limitation that was related to time was about conducting group discussions during one phase only of the study rather than all study phases (Tseng et al., 2019).

e. Other Technologies and Digital Tools

Two studies have mentioned the limited number of technological tools used in the study as a limitation (Cam & Koc, 2021; Tseng et al., 2019).

2.4.7 Future Studies

Several suggestions have been made by the articles included in this review concerning future studies. These suggestions were divided by the authors into six categories. The category that was mentioned by the highest number of articles was related to the research methods and tools (n=15), and it was followed by that about replicating the study in different contexts, disciplines, or courses (n=13), including more and different participants (n=13), study duration (n=10), and using other technologies and digital tools (n=5). Moreover, there were some other miscellaneous future study suggestions (n=7).

a. Research Methods and Tools

Nine articles have recommended using a mixed-methods research design. For instance, Akay (2017), whose study was qualitative, has suggested incorporating quantitative methods next to the qualitative ones. Others, whose studies were quantitative, have suggested incorporating qualitative methods in addition to the quantitative ones (Chai et al., 2017; Merono et al., 2021; Miguel-Revilla et al., 2020; Rienties et al., 2020; Saltan & Arslan, 2017; Valtonen et al., 2018; Valtonen et al., 2019; Xiong et al., 2020). In addition, a suggestion was made in a mixed-method study to use quantitative methods with qualitative analysis for future studies (Rets et al., 2020).

On the other hand, some studies have specified other methods and instruments to be used in future studies. Four studies have suggested observing pre-service teachers' performance during field placements at schools (Gill & Dalgarno, 2017; Oakley, 2020; Tiba & Condy, 2021;

Tondeur et al., 2020). Other recommendations were made for using questionnaires and surveys (Gill & Dalgarno, 2017; Nguyen & Bower, 2018; Tiba & Condy, 2021), lesson plans (Valtonen et al., 2019), discourse analysis (Nguyen & Bower, 2018), case studies (Oakley, 2020), and interviews (Valtonen et al., 2019). One study has suggested employing stimulated recall interviews where pre-service teachers will be asked to verbalize their comments and ideas while looking at their performance on video (Tondeur et al., 2020).

b. Contexts, Disciplines and Courses

Nine studies have suggested replicating future studies in different institutions and universities (Al-Abdullatif, 2019; Chai et al., 2017; Kaplon-Schilis & Lyublinskay, 2020; Redmond & Lock, 2019; Saltan & Arslan, 2017; Tiba & Condy, 2021; Tondeur et al., 2017; Tunjera & Chigona, 2020; Xiong et al., 2020). One of these studies has recommended replicating future studies outside the Flemish context (Tondeur et al., 2017), and another one has suggested replicating them in elite and poorly funded schools (Chai et al., 2017).

Moreover, five studies have recommended replicating the study in different courses or disciplines (Asik et al., 2018; Cetin-Dindar et al., 2018; Miguel-Revilla et al., 2020; Redmond & Lock, 2019; Valtonen et al., 2019). Doing so will help in finding out the effect of the different courses on pre-service teachers' TPACK.

c. Participants

Nine studies have suggested including other stakeholders in future studies. Four of these studies have recommended targeting in-service teachers (Al-Abdullatif, 2019; Lee & James, 2018; Tondeur et al., 2017; Tseng et al., 2019). One of these studies (Tseng et al., 2019) has mentioned that the targeted in-service teachers should be experienced ones, while another study (Lee & James, 2018) has suggested studying in-service teachers who are resistant to change. Other studies have suggested including academic staff (Cetin-Dindar et al., 2018), students at schools and classroom and subject area teachers (Cindric & Greguric, 2019), mentor teachers (Gill & Dalgarno, 2017), administrators and teacher educators (Tiba & Condy, 2021), and pre-service teachers with similar backgrounds (Luik et al., 2018).

Concerning pre-service teachers, some have suggested identifying them into subgroups based on their TPACK assessment (Valtonen et al., 2019) rather than studying them as one homogeneous group since this would help in developing teacher education practices that meet the needs of the varying abilities of pre-service teachers (Valtonen et al., 2018).

As for the sample size, six studies have recommended incorporating more participants in the study to be able to generalize the results (Al-Abdullatif, 2019; Cetin-Dindar et al., 2018; Kaplon-Schilis & Lyublinskay, 2020; Karatas et al., 2017; Tiba & Condy, 2021; Tseng et al., 2019).

d. Study Duration

Nine studies have recommended conducting longitudinal studies to track pre-service teachers' TPACK development over time (Akay, 2017; Asik et al., 2018; Cetin-Dindar et al., 2018; Durdu & Dag, 2017; Kapici & Akcay, 2020; Saltan, 2017; Tondeur et al., 2020; Valtonen et al., 2018; Valtonen et al., 2019). This includes monitoring pre-service teachers' TPACK at the university, during field placement, and then during their in-service teaching. Moreover, one other study has suggested increasing the observation hours of teacher educators' TPACK-based lessons (Cam & Koc, 2021).

e. Other Technologies and Digital Tools

Five studies have suggested using the same intervention but with different technologies and digital tools than those that have been used in the original studies (Akay, 2017; Cam & Koc, 2021; Durak, 2021; Saltan, 2017; Tseng et al., 2019). This will help in identifying the effect of other tools on the TPACK development of pre-service teachers.

f. Other Recommendations for Future Studies

In addition to the above-mentioned suggestions for future studies, other recommendations have been proposed by different authors. For instance, Kaplon-Schilis and Lyublinskay (2020) have recommended identifying the factors that influence the TPACK development of pre-service teachers. Others have suggested studying the effects of internal and external enablers and barriers on instructional technology integration and the role of the teacher education program in preparing pre-service teachers to make the best use of the available enablers and to overcome the barriers they may face at schools later on (Admiraal et al., 2017). Moreover, others have supported studying the influence of mentor teachers' modeling and the influence of technology modeling and attitudes in pre-service teachers' own K-12 education on their attitude towards technology integration (Zipke et al., 2019). The remaining recommendations were related to studying the method that can be used to assess pre-service teachers' post-intervention TPACK level (Kapici & Akcay, 2020), studying the perceived TPACK development in online settings (Rets et al., 2020), implementing the TPACK model in professional development programs (Alrwaished et al., 2017), and conducting studies that would help pre-service teachers make a connection between the technological tool and its instructional purpose.

2.5 Theoretical Review Discussion

The main objectives of this chapter were to examine participants' characteristics, methodological designs, main results, challenges, recommendations, limitations, and future research suggestions provided by the 46 articles that were included in this review.

As for the geographical distribution, the vast majority of the studies have been conducted in Turkey and in European countries. More studies are thus to be conducted in other parts of

the world, like the Arab countries, Africa, and America. As for Lebanon, the need to conduct such studies is of utmost importance as it enables the examination of the existing state of technology integration in teacher education programs, helps in the improvement of pedagogical practices, and ensures that educators are equipped with the necessary competencies to effectively integrate technology into their teaching, aligning Lebanon's education system with the demands of the digital era. Further studies are to include developed and developing countries, as this will help in studying the influence of different cultures, educational systems, and policies on TPACK implementation. Pre-service teachers, in-service teachers, teacher educators, mentor teachers, and school students in different cultures may have different starting points as to their TPACK perceptions, attitudes, and readiness to integrate or use technology. They may also have different culture-bound enablers and barriers. Identifying these points would provide us with a comprehensive view as to the best practices to integrate technology and overcome the barriers in every culture.

The majority of the participants in these studies were pre-service teachers followed by in-service teachers and teacher educators. The participation of school students was very limited, whereas the participation of policy makers and administrators was not addressed in any study. Stakeholders of TPACK implementation include policy makers, administrators at the educational institutions, teacher educators, pre-service teachers, in-service teachers, school teachers and their students. Tunjera and Chigona (2020) have mentioned that academic institutions do not have clear policies regarding the adoption of technology integration frameworks and that teacher educators fail to integrate technology because they are not adopting these frameworks. Thus, the absence of clear policies and strategies may obstruct the effective implementation of TPACK. Moreover, the overall aim of TPACK implementation at teacher education programs is to prepare future teachers to effectively integrate technology during their instructional practices at schools. This means that the target group at the end is school students. Thus, to have a comprehensive view of the implementation process, future studies should start with policy makers and administrators and end up with studying the effects on school students. This was missing in the studies included in this systematic review. Another important point that was missing in several articles was mentioning the academic degree level of the pre-service participants. Some of these articles aimed at evaluating pre-service teachers' perceptions, attitudes, confidence level or readiness to integrate technology, while others aimed at assessing the effectiveness level of certain approaches, courses or technologies. Not identifying the academic level of the pre-service teachers would lead to an inaccurate reading and analysis of the results. Thus, future studies need to bluntly mention the academic degree level of the participants to avoid any ambiguity in the results. In addition, the data reviewed shows that the study samples are modest, especially when it comes to teacher educators (between 3 and 12 teacher educators). This might suggest the need to develop research with larger samples as this will help in generalizing the results, or to address the research questions from a qualitative aspect. Moreover, and as expected, most participants were females, so further studies may try to target education majors that have higher numbers of male students and compare results based on the gender.

Most articles have used either the quantitative or the qualitative design. More studies are needed to adopt the mixed method in order to study and analyze different aspects of the intended objective. Concerning the tools, the mostly used ones were questionnaires and then interviews. The main problem with the questionnaires is their self-reporting nature that triggers the participants to either overestimate or underestimate their abilities. Other instruments that were used are course artefacts and reflections. However, these studies have missed a very important instrument which is the observation of pre-service teachers while delivering their lessons during the field placement at schools. Doing so would provide us with good data on the effectiveness of the methods used at the teacher education programs to help pre-service teachers integrate technology in teaching. This is because pre-service teachers would reflect what they have learned into practice during field placements. Based on the results, gaps would be identified and courses would be redesigned to tackle these gaps and promote pre-service teachers' experience in technology integration.

Almost half of the studies haven't adopted intervention methods. This is probably an area to continue exploring. As for the other studies, their intervention durations were comparatively short and ranged from 5 weeks to one year. This may help in assessing the short-term benefits of a certain course, but not the whole teacher education program. More longitudinal studies are thus needed to assess pre-service teachers' TPACK development, starting from technology-integrated classes to field placements to in-service teaching. Most approaches, courses, and technologies adopted were found to help in TPACK development. Although pre-service teachers also showed positive perceptions towards TPACK, teacher education programs were found to not adequately or sufficiently prepare them to integrate technology in teaching. The factors that were frequently mentioned as the ones that would promote technology integration are the mentor teachers' and teacher educators' roles, support and technology integration modeling, and hands-on experience.

As for the challenges identified in the studied articles, they were present at all levels, starting at the teacher education programs at universities and institutes and ending at the schools where pre-service teachers had to do their field placements. They also included the major and most influential components of the teaching process, like teacher educators and mentor teachers. These multi-level challenges reflect the chances pre-service teachers are missing to adequately develop their TPACK skills. The major obstacle to technology integration is found to be technology itself. Teachers are asked to integrate technology into school teaching when these schools are not fully tech-equipped or even lack the minimum technological requirements to carry out this process. This means that, even if pre-service teachers were properly trained to integrate technology into the teacher-education program, they would miss the real chance to reflect, implement, and transfer their theoretical knowledge into a practical one in a real teaching-learning environment at schools. Moreover, pre-service teachers are missing the chance to not only practically integrate technology in real environments but also to be exposed to role models who can exemplify how teachers should integrate technology in different subject matters. Studies have shown that many teacher educators and mentor teachers lack the skills to play this role.

The studies have provided more in-depth recommendations that tackle the identified challenges at all levels. They have included policymakers as part of the solution and have provided a detailed description of how courses, workshops, and field placements should be designed considering the assessment criteria, pedagogical methods, and instructional materials, tasks, and activities. They have also provided some suggestions related to teacher educators' role not only towards pre-service teachers but also towards their colleagues. This point reflects the importance of collaboration among teacher educators and the role this collaboration plays in enhancing technology integration across the whole program. Also, if we compare the number of challenges that are related to technology (n=14) to the number of recommendations that are related to technology (n=4), we find a big difference. This discrepancy may reflect the lack of attention directed towards supporting educational institutions with appropriate technology, despite being a major challenge.

The limited number of participants, courses, institutions, and technological tools, the self-reported nature of the instruments, the dependence on quantitative instruments, the absence of triangulation, and the short study duration were the major limitations mentioned in the articles that were included in this review.

Finally, several suggestions have been made for future studies. Most suggestions were related to the research methods and tools and recommended conducting mixed-methods studies and observing pre-service teachers' performance during field placements. They were followed by recommendations about replicating the study in different contexts, disciplines, or courses, including more and different participants, increasing the study duration, and using other technologies and digital tools.

The major limitation of this systematic review is that it depends only on one database, which is the Web of Science. Including other databases in the study could have yielded a higher number of articles with different objectives.

As for future research, it may study the effect of all courses in the teacher education program and not one course only. This includes studying the course content, delivery, projects, technology use intensity, assessment, and effects. This would provide a guide on what kind of courses to include in the teacher education program, at what point in the teacher education program to offer each course, what course should be a pre-requisite, what course to remove, and what course to redesign. Also, future research could conduct longitudinal studies to track pre-service teachers' TPACK development.

2.6 Conclusion

This chapter has reviewed 46 papers that discussed technology integration in teacher education programs based on the TPACK framework. It has aimed at providing an overview on the different aspects upon which TPACK has been tackled whether that was related to perceptions or practical applications. It has identified the participants, methodological designs, main results, challenges, recommendations, limitations and future research suggestions of the

studied articles. The results of this systematic review provide insights for researchers, policy makers and educators. Researchers can capitalize on the limitations and future research suggestions results to get inspired about their next research topic. Policy makers can check the results of the challenges and the recommendations to guide them in their decisions as to what to change and what to reinforce. As for educators, whether they were teacher educators, pre-service teachers or in-service teachers, they can benefit from the results and can refer to the intervention methods to check the most effective and successful practices to integrate technology in teaching. They can also benefit from the corresponding challenges they faced and the recommendations that were provided to them to develop the areas that need some improvement.

Chapter 3: Methodology

3.1 Research Design

To answer the research questions, the mixed-method triangulation approach was adopted. This approach was proposed by Creswell (2014), and it incorporates both qualitative procedures and quantitative methods. It was employed given the need to know more about, examine, and compare various viewpoints and experiences about pre-service teachers' university education programs. Denzin and Lincoln (2005) state that the mixed-methods approach is a common approach to conducting research in the social and human sciences.

The mixed-method approach paves the way to a multifaceted and in-depth analysis and comprehension of the research problem (Creswell, 2005), since it yields complex evidence (Creswell & Plano Clark, 2007). Moreover, since it incorporates both qualitative and quantitative approaches, using the mixed method alleviates the drawbacks or flaws that might result from using only one of these methods (Creswell, 2014). This will help to cross-reference both data types to assure credibility (Bergman, 2009). Additionally, according to Creswell (2014), a mixed-method approach enables the researcher to repeat the findings of the results in other contexts and settings. As a result, a greater variety of academics and stakeholders find the mixed-method approach appealing.

Limited research has been conducted on the topic under study in Lebanon; thus, a thorough investigation of the issue is required. This study specifically followed the concurrent mixed-method approach, which merges quantitative and qualitative data in order to provide a comprehensive analysis of the research problem. In this design, both forms of data were collected at the same time, and then the information was integrated in the interpretation of the overall results.

- The **quantitative data** were collected from in-service teachers' and pre-service teachers' surveys.
- The **qualitative data** were collected from interviews with the administrators, teacher educators, in-service teachers, and pre-service teachers, in addition to document analysis (syllabus).

3.2 Research Context

This study was carried out across the nine campuses of a private university in Lebanon. This university was purposefully selected by the researcher due to the variety of Education programs it offers and the diversified sample of registered future teachers. The education programs at this university fall under the School of Education. The degrees offered are Bachelor of Education, Teaching Diploma in Education, and Masters of Education. Currently, the School of Education has 2723 students registered in the Bachelor program and 1102 students registered in the Teaching Diploma and Masters programs.

The specialties that fall under the Bachelor of Education are: Teacher Education (focus on Math and Physics or Chemistry and Biology), Early Childhood Education (CHED), and

Teaching English as a Second Language (TESL). To get a Bachelor of Education, students need to complete a three-year program consisting of 99 credits distributed as follows: thirty-three credits as major requirements (these courses differ based on the specialty), thirty-six credits as core requirements (these courses are common among all Bachelor education specialties), fifteen credits as general education requirements (include two English courses, an Arabic language course, civilization course, and an introduction to computers course), six credits as major electives, and nine credits as general electives. During their third year, students need to register for two practicum courses that aim at providing them with a practical teaching experience in a natural classroom setting. These practicum courses are offered in Fall and Spring. Practicum I is a pre-requisite course for Practicum II, which means that students need to finish Practicum I before they are allowed to register for Practicum II. Practicum I course is designed to help pre-service teachers learn by example by allowing them to observe a cooperating teacher in a real classroom setting. In the fall semester, each pre-service teacher is assigned a specific classroom to attend and observe at any school in Lebanon. In total, pre-service teachers need to observe 40 hours in the assigned school. As for Practicum II, it is designed to help pre-service teachers learn by example and practice teaching. They are expected to manage the classroom activities themselves, plan and deliver some lessons, and assist the cooperating teacher. In the spring semester, each pre-service teacher is assigned a specific classroom at any school in Lebanon. In total, pre-service teachers need to cover 40 hours of both observation and practice teaching in the assigned school.

As for the Teaching Diploma in Education, students need to complete a one-year program consisting of 24 credits distributed as follows: twenty-one credits as major requirements and three credits as major electives. It is worth mentioning that the Teaching Diploma degree offered at this university is general and doesn't target specific areas of specialization.

Students pursuing their Masters in Education should complete a two-year program consisting of 39 credits distributed as follows: fifteen credits as major requirements (these courses differ based on the specialty), twenty-one credits as core requirements (these courses are common among all Masters education specialties), and three credits as major electives.

3.3 Participants

The participants who were recruited from this university include pre-service teachers, in-service teachers who graduated from this same university under study, teacher educators, and administrators (Assistant Deans and Chairs).

Table 6 shows the number of participants in the interview and the questionnaire.

Table 6. Participants per instrument

	Interviews	Questionnaire
Pre-service Teachers	57	187
In-service Teachers	20	52
Teacher Educators	21	-
Administrators	6	-
Total	**104**	**239**

3.3.1 Pre-Service Teachers

In total, 187 pre-service teachers filled out the questionnaire, and 57 took part in the interview. Table 7 below shows the general information for pre-service teachers who participated in the questionnaire.

Table 7. General information of the questionnaire's pre-service participants

	N	%
Gender		
Female	169	90.4
Male	18	9.6
Age Range		
18 - 22	76	40.6
23-26	40	21.4
27-32	28	15.0
More than 32	43	23.0
Major		
Bachelor in Early Childhood Education	42	22.5
Bachelor in Teaching English as a Second Language	44	23.5
Bachelor in Teacher Education (Physics - Mathematics)	6	3.2
Bachelor in Teacher Education (Biology - Chemistry)	2	1.1
Bachelor in Literature	5	2.7
Teaching Diploma in Education	32	17.1
Master's of Education in Educational Management	50	26.7
Master's of Education in Teaching English as a Foreign Language	6	3.2
Are you currently enrolled or have you completed a practicum experience in a PreK-12 classroom?		
Yes	122	65.2
No	65	34.8

The majority of pre-service teachers who participated in the questionnaire were females. This is expected as most students who usually join the education program in Lebanon are

females. Teaching in Lebanon is considered a female major and profession. Moreover, almost half of the participants were registered in the education undergraduate program and the second half in the graduate program. Almost two-thirds of pre-service participants have enrolled in or completed the practicum experience.

Table 8 below shows the general information for pre-service teachers who participated in the interview.

Table 8. General information of the interview's pre-service participants

	N	%
Gender		
Female	51	89.47
Male	6	10.53
Age Range		
18 - 22	20	35.09
23-26	16	28.07
27-32	5	8.77
More than 32	16	28.07
Major		
Bachelor in Early Childhood Education	7	12.28
Bachelor in Teaching English as a Second Language	12	21.05
Bachelor in Teacher Education (Physics - Mathematics)	1	1.75
Bachelor in Teacher Education (Biology - Chemistry)	1	1.75
Bachelor in Literature	0	0.00
Teaching Diploma in Education	12	21.05
Master's of Education in Educational Management	18	31.58
Master's of Education in Teaching English as a Foreign Language	6	10.53
Are you currently enrolled or have you completed a practicum experience in a PreK-12 classroom?		
Yes	38	66.67
No	19	33.33

As in the questionnaire, most preservice interview participants were females. Moreover, almost one-third of the participants were registered in Education undergraduate studies and the rest in graduate studies. Also, around two-thirds of pre-service participants have enrolled in or completed the practicum experience.

3.3.2 In-Service Teachers

In total, 52 in-service teachers filled out the questionnaire, and 20 took part in the interview.

Table 9 below shows the general information for in-service teachers who participated in the questionnaire.

Table 9. General information of the questionnaire's in-service participants

	N	%
Gender		
Female	47	90.4
Male	5	9.6
Age Range		
Under 25	19	36.5
25-29	20	38.5
30-39	12	23.1
40 or more	1	1.9
Highest Degree Earned		
Bachelor's in early childhood education	12	23.1
Bachelor's in teaching English as a Second Language	8	15.4
Bachelor in Teacher Education (Physics - Mathematics)	5	9.6
Bachelor in Teacher Education (Biology - Chemistry)	1	1.9
Teaching Diploma in Education	13	25.0
Master of Education in Educational Management	10	19.2
Master of Education in Teaching English as a Foreign Language	3	5.8
Years of teaching at school level		
1-3	28	53.8
4-5	12	23.1
6-9	4	7.7
10-14	6	11.5
15-19	1	1.9
20 or more	1	1.9
Subject Areas Taught*		
Mathematics	19	36.5
Sciences	13	25.0
English	33	63.5
French	3	5.8
Arabic	4	7.7
Arts	5	9.6
Computer	4	7.7
Social Studies	2	3.8
Physical Education	1	1.9
Other	3	5.8
Levels Taught*		
Kindergarten (KG)	21	40.4
Elementary	25	48.1
Intermediate	16	30.8
Secondary	10	19.2
What school type do you teach at?*		
Private School	48	92.3
Public School	8	15.4
Years using digital technologies in teaching		
I haven't yet used digital technologies in teaching	3	5.8
Less than one year	14	26.9
1-3	22	42.3
4-5	5	9.6

6-9	5	9.6
10-14	2	3.8
15-19	1	1.9
I haven't yet used digital technologies in teaching	3	5.8

**Participants can choose more than one answer*

Again, most in-service teachers who filled out the questionnaire were females under the age of 30. Half of the in-service teachers had an undergraduate degree in education and half had a graduate degree. More than half have been teaching for 1 to 3 years, which reflects that most of them were fresh graduates. Also, most of them teach Kindergarten and elementary levels at private schools. The majority of subject matters they taught were major ones like English, Mathematics, or Sciences. Finally, most of them haven't been using technology in teaching for a long time (less than one year to three years). Of these 22 in-service teachers who have been using technology in teaching for 1 to 3 years, there are 19 who have been teaching for 1 to 5 years. This reflects that technology integration is mostly applied by fresh graduates.

Table 10 below shows the general information for in-service teachers who participated in the interview.

Table 10. General information of the interview's in-service participants

	N	**%**
Gender		
Female	20	100
Male	0	0
Age Range		
Under 25	4	20.00
25-29	11	55.00
30-39	4	20.00
40 or more	1	5.00
Highest Degree Earned		
Bachelor's in early childhood education	7	35.00
Bachelor's in teaching English as a Second Language	3	15.00
Bachelor in Teacher Education (Physics - Mathematics)	1	5.00
Bachelor in Teacher Education (Biology - Chemistry)	0	0.00
Teaching Diploma in Education	7	35.00
Master of Education in Educational Management	1	5.00
Master of Education in Teaching English as a Foreign Language	1	5.00
Years of teaching at school level		
1-3	11	55.00
4-5	6	30.00
6-9	3	15.00
10-14	0	0
15-19	0	0
20 or more	0	0
Subject Areas Taught*		

Mathematics	3	15.00
Sciences	3	15.00
English	15	75.00
French	0	0.00
Arabic	5	25.00
Arts	2	10.00
Computer	3	15.00
Social Studies	1	5.00
Physical Education	0	0.00
Other	1	5.00
Levels Taught*		
Kindergarten (KG)	7	35.00
Elementary	10	50.00
Intermediate	7	35.00
Secondary	6	30.00
What school type do you teach at?*		
Private School	19	95.00
Public School	3	15.00
Years using digital technologies in teaching		
I haven't yet used digital technologies in teaching	0	0
Less than one year	4	20.00
1-3	11	55.00
4-5	4	20.00
6-9	1	5.00
10-14	0	0
15-19	0	0

**Participants can choose more than one answer*

All in-service teachers who participated in the interview were females with the majority under the age of 30 and more than half having an undergraduate degree in Education. Most of them are fresh graduates who have been teaching for less than 5 years. They mostly teach languages like English and Arabic, with more than half teaching at the elementary level. Almost all of them teach at private schools. Also, more than half have been using digital technology in teaching for 1 to 3 years.

3.3.3 Teacher Educators

The third participant group in this study were teacher educators in the Education program. A total of 21 teacher educators have participated in the interview.

Table 11 shows the general information for teacher educators who participated in the interview.

Table 11. General information of the interview teacher educator participants

	N	%
Gender		
Female	18	85.71
Male	3	14.29
Highest Degree		
Master's Degree	16	76.19
PhD	5	23.81
Years of teaching experience		
Less than one year	0	0
1-3	1	4.76
4-5	5	23.81
6-9	5	23.81
10-14	7	33.33
15-19	1	4.76
20 or more	2	9.52

Most teacher educators were females holding a master's degree. Almost half of them have been teaching for between 1 and 9 years, and one third have been teaching for 10 to 14 years.

3.3.4 Administrators

Finally, six assistant deans of the School of Education have participated in the interview. Five of these assistant deans were females and one was male. Their years of experience in their position range from 4 to 8 years.

3.4 Instruments

Three instruments were used in this study: an adapted version of the Survey of Preservice Teachers' Knowledge of Teaching and Technology, semi-structured interviews, and document analysis of the syllabi.

Figure 4 shows the methodology adopted for this study.

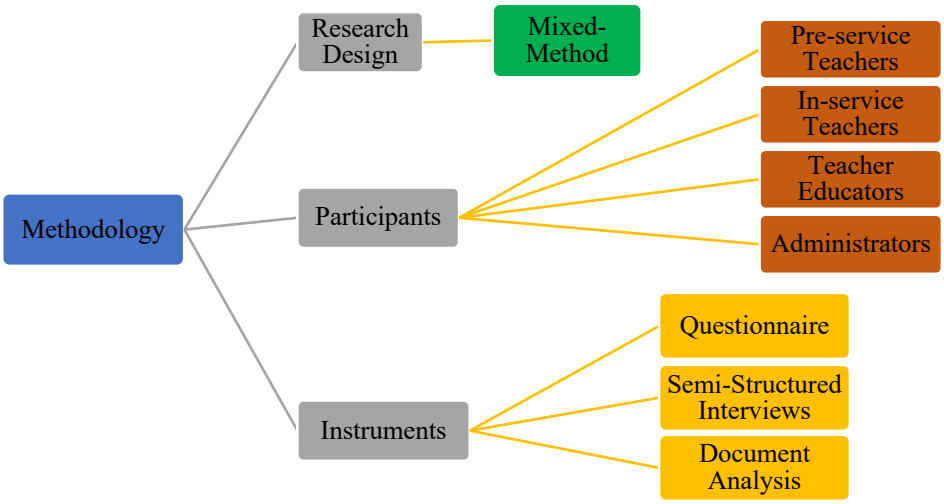

Figure 4. Study methodology

3.4.1 Questionnaire

The questionnaire used in this study is an adapted version of the Survey of Preservice Teachers' Knowledge of Teaching and Technology developed by Schmidt et al. (2009). This survey was initially developed for use with pre-service teachers; however, as none of the questions is specific for pre-service teachers, it was also adapted to be used for in-service teachers in this study.

The questionnaire is composed of 2 sections: The major section studies teachers' perceptions of each TPACK construct, while the second section studies teachers' perceptions of the models of TPACK, or the faculty and school teachers who should usually act as models for future teachers.

The first section of the original survey includes 46 items. However, the CK, PCK, TCK, and TPACK constructs included items that target individual subject matters like mathematics, social studies, science, and literacy. In the adapted version (Appendix A), these subject matters were grouped and substituted by "my first teaching subject"; thus, the number of items went down to 28. A Likert scale that ranges from 1 to 5 was used for these questions, with 1 representing strongly disagree and 5 representing strongly agree.

- 6 items that assess TK
- 3 items that assess CK
- 7 items that assess PK
- 1 items that assess PCK
- 1 items that assess TCK
- 9 items that assess TPK
- 1 items that assess TPACK

As for the section on models of TPACK, first it asks about whether education professors, professors outside of education, and PreK-12 cooperating teachers have appropriately modelled combining content, technologies, and teaching approaches in their teaching. It then asks about the percentage of education professors, professors outside of education, and PreK-12 cooperating teachers who have provided an effective model of combining content, technologies, and teaching approaches in their teaching. This section was adapted to include PreK-12 teachers instead of PreK-6 teachers. Also, subject matters for education instructors were grouped into one item instead of 6.

The questionnaire was developed on Google Forms and shared with all Education pre-service teachers and in-service teachers who graduated from the same university under study. The final number of participants was 187 pre-service teachers and 51 in-service teachers.

a. Questionnaire Reliability

The reliability test determines the consistency of the measure, meaning that if the same survey is repeated with different informants at different points in time, the same findings would be obtained. Thus, a reliability test for the adapted questionnaire was made using Cronbach Alpha, and the value obtained was 0.942, thus highlighting strong reliability.

3.4.2 Semi-Structured Interviews

Semi-structured interviews were conducted with 57 pre-service teachers, 20 in-service teachers, 21 teacher educators, and 6 administrators. There were 5 to 6 interview questions for each group (Appendix B).

A pilot study for the interview questions was done first on a small number of participants in order to make sure the questions were clear enough and to obtain high-quality responses. Minor changes to the questions' wording were made as a result of this pilot study.

Pre-service teachers, in-service teachers, and teacher educators were asked about their competency in using technology, the best practices to integrate technology in teaching, the main barriers, and the improvements that could be made at the level of TEP to promote technology integration. Pre-service teachers and in-service teachers were also asked about the degree to which the TEP has prepared them to integrate technology in teaching. As for the administrators, they were asked about the degree to which technology is being integrated at the different levels and courses in the TEP. They were also asked about whether there are any rules or guidelines related to technology integration at the TEP and how they support this integration. Moreover, they were asked about the barriers and the improvements that could be made at the TEP level to promote technology integration.

3.4.3 Document Analysis (Syllabi)

The course syllabi of 45 courses in the Teacher Education Program were analyzed. That includes 28 undergraduate courses and 17 graduate courses. The courses analyzed were the major and core courses in the program.

The course outcomes for every course were studied and identified as TK, PK, CK, TPK, TCK, PCK, or TPACK. Some examples of these constructs were: to create an e-portfolio (TK) in the Educational Technology for Teachers course; to design an effective assessing system for students' achievement (PK) in the Methods of Teaching and Testing course; to identify the parts of the vocal tract and their roles in speech production (CK) in the Phonology course; to plan for technology integration that maximizes motivation, engagement, efficacy, and efficiency with respect to learning (TPK) in the Educational Media and Technology course; and to design engaging activities to promote reading and writing (PCK) in the Literacy and Language Development course. As for TCK and TPACK, they were not addressed in any course outcome. More examples are provided in tables 25 and 27.

3.5 Data Collection Procedures

First, I got the approval to conduct the study from the President of the university under study through the Dean of the School of Education. I sent the Dean an email with my study proposal and all the documents related to my study, like the interview questions and the questionnaire. He in turn sent it to the university president and got his approval to conduct the study.

Second, I contacted the Ethics Committee for Research in People, Society, and the Environment (CEIPSA) at URV, represented by Mr. Carlos Garcia at **carlos.garcia@urv.cat** and sent them all the required documents, like the information sheet for participants (Appendix C) and the informed consent form (Appendix D), and got their approval (favorable report: CEIPSA-2022-TD-0001) to conduct the study (Appendix E). The information sheet for participants and the informed consent form were shared with the participants of both the questionnaire and the interview. The information sheet for participants provided information about the study and its purpose. It also made it clear to participants that their participation is voluntary and that they may decide not to participate, change their decision, or withdraw their consent at any time. It also indicated that the privacy of the collected data would be maintained.

3.5.1 Questionnaire

To use the TPACK survey, the approval of Dr. Denise Schmidt was granted (Appendix F) after emailing her the description of the intended usage (research questions, population, etc.) and the site location for my research. After getting the approval to use the survey, pre-service teachers and in-service teachers who graduated from the same university under study received an email from the Dean with a link to the online questionnaire, which was developed using Google Forms. The email made it clear that participants have the right to accept or reject filling

out this questionnaire. The final number of participants was 187 pre-service teachers and 51 in-service teachers.

3.5.2 Semi-Structured Interviews

Participants received an email from the Dean with an invitation to participate in an interview. The email made it clear that participating in the interview was merely voluntary. Those who accepted to participate had to fill out a Google form where they had to provide their phone numbers and their time availability to conduct the interview.

The interviews were conducted by the researcher over the phone due to COVID-19 challenges, and some were sent in written format. The average duration for every interview was about 15 minutes, and the overall duration for the whole interviews was about a month. The overall word count for the interview transcriptions was 33,505 words: 11,420 words for pre-service teachers; 5,391 words for in-service teachers; 14,009 words for teacher educators; and 2685 for administrators.

3.5.3 Document Analysis (Syllabi)

The syllabi of the graduate courses and the undergraduate courses were shared by the Director of Graduate Studies in Education and the Chair of the Education Department, respectively. A sample of these syllabi is found in Appendix G.

The rubric for the document analysis was derived from the TPACK framework. Two Excel sheets were created, one for the undergraduate courses and one for the graduate courses. Each sheet included the seven TPACK constructs horizontally (TK, PK, CK, TPK, TCK, PCK, and TPACK). The name of each course was added vertically, and a check mark was inserted under each construct that was addressed in the learning outcomes of that course. If one of the constructs wasn't addressed in the syllabus, an x was added. Figure 5 below shows a sample of the graduate syllabi rubric.

	TPACK Construct / Course	PK	CK	TK	PCK	TCK	TPK	TPACK
EDUC511	Classroom Dynamics	✓	✓	x	x	x	x	x
EDUC520	Philosophy of Education	x	✓	x	x	x	x	x
EDUC556	Advanced methods of Teaching Humanities and Language	✓	✓	x	x	x	x	x
EDUC557	Advanced Methods of Teaching Science and Math	✓	✓	x	✓	x	✓	x
EDUC561	Educational Media and Technology	x	✓	x	x	x	✓	x
EDUC565	Assessment and Evaluation	✓	✓	x	x	x	x	x
EDUC600	Curriculum Design and Evaluation	✓	✓	x	x	x	x	x
EDUC660	Teaching Practices	✓	✓	x	x	x	✓	x
EDUC667	Counseling: Theory and Practice	✓	✓	x	x	x	x	x
EDUC677	International Education Administration & Policy Analysis	x	✓	x	x	x	x	x
EDUC694	Graduate Research Project	x	✓	x	x	x	x	x
EDUC551	Research Methodology and Dissertation Preparation	x	✓	x	x	x	x	x
EDUC580	Practicum in Educational Management and Leadership	✓	✓	x	x	x	x	x
EDUC610	Applied Linguistics	x	✓	x	✓	x	x	x
EDUC631	Content Area Education for TESL Students	x	✓	x	✓	x	x	x
EDUC640	Strategic Planning in Education	x	✓	x	x	x	x	x
EDUC646	Literacy and Language development	✓	✓	x	✓	x	x	x
		9/17	17/17	0/17	4/17	0/17	3/17	0/17

Figure 5. Sample document analysis rubric

3.6 Data Analysis Procedures

Datasets from the questionnaires of pre-service teachers and in-service teachers were statistically analyzed using SPSS software version 25. The frequency, mean, and standard deviation were calculated for the general information of participants and for each individual item in the survey. Moreover, the t-test was used to calculate the relation between TPACK and gender, TPACK and degree (undergraduate/graduate), and TPACK and practicum experience. On the other hand, the ANOVA test was used to study the relationship between TPACK and age, TPACK and year at university, TPACK and years of teaching, and TPACK and years of teaching digital technologies in teaching.

Concerning the interviews, NVivo software version 12 was used. The interview transcripts were entered into NVivo software, and then codes were made. These codes helped in deriving themes for every question.

As for the document analysis, a predetermined rubric was used to indicate the TPACK constructs that were present in each course syllabus. After that, the total frequency for every individual TPACK construct was calculated for undergraduate and graduate courses. Then, a comparison of the TPACK constructs was made, and an analysis was driven.

Chapter 4: Results

In this chapter, the study findings will be listed as per research instrument. Table 12 below shows the tools used per participant group to answer each one of the 5 research questions (RQ).

Table 12. Tools used per research question

	RQ1 TPACK Perception	**RQ2 Impediments**	**RQ3 Improvements**	**RQ4 Best Practices**	**RQ5 TEP Preparation**
Pre-service teachers	1.Interview (Q1) 2.TPACK Survey	Interview (Q2)	Interview (Q3)	Interview (Q4)	1.Interview (Q5) 2.TPACK Survey
In-service teachers	1.Interview (Q1) 2.TPACK Survey	Interview (Q3)	Interview (Q4)	Interview (Q5)	1.Interview (Q2,6) 2.TPACK Survey
Teacher educators	1.Interview (Q1)	Interview (Q4)	Interview (Q5)	Interview (Q6)	Interview (Q2,3)
Administrators at the TEP	-	Interview (Q4)	Interview (Q5)	-	Interview (Q1,2,3)
	-	-	-	-	Document Analysis of TEP course syllabi

4.1 TPACK Questionnaire Items

The participant groups who filled out the questionnaire are pre-service teachers and in-service teachers.

4.1.1 Pre-Service Teachers Questionnaire Results

Table 13 below displays the detailed results for the pre-service teachers' TPACK questionnaire. It shows the frequencies (N) and the percentages (%) of the whole sample of pre-service teachers per TPACK item.

Table 13. Pre-service teachers' results of TPACK constructs

	Strongly Disagree		**Disagree**		**Neither Agree or Disagree**		**Agree**		**Strongly Agree**			
Code	**1**		**2**		**3**		**4**		**5**			
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**Mean**	**Std. Deviation**
1	9	4.8	10	5.3	32	17.1	92	49.2	44	23.5	**3.81**	1.012
2	7	3.7	10	5.3	13	7.0	72	38.5	85	45.5	**4.17**	1.026

3	5	2.7	13	7.0	31	16.6	81	43.3	57	30.5	**3.92**	0.994
4	9	4.8	15	8.0	42	22.5	91	48.7	30	16.0	**3.63**	1.004
5	9	4.8	10	5.3	47	25.1	83	44.4	38	20.3	**3.70**	1.009
6	5	2.7	11	5.9	32	17.1	96	51.3	43	23.0	**3.86**	0.929
7	12	6.4	7	3.7	21	11.2	84	44.9	63	33.7	**3.96**	1.087
8	9	4.8	9	4.8	31	16.6	82	43.9	56	29.9	**3.89**	1.042
9	12	6.4	5	2.7	19	10.2	85	45.5	66	35.3	**4.01**	1.070
10	11	5.9	5	2.7	23	12.3	83	44.4	65	34.8	**3.99**	1.055
11	9	4.8	3	1.6	27	14.4	90	48.1	58	31.0	**3.99**	0.978
12	10	5.3	6	3.2	24	12.8	86	46.0	61	32.6	**3.97**	1.034
13	10	5.3	7	3.7	21	11.2	83	44.4	66	35.3	**4.01**	1.050
14	11	5.9	8	4.3	28	15.0	83	44.4	57	30.5	**3.89**	1.072
15	11	5.9	7	3.7	28	15.0	93	49.7	48	25.7	**3.86**	1.035
16	12	6.4	6	3.2	30	16.0	88	47.1	51	27.3	**3.86**	1.060
17	11	5.9	6	3.2	23	12.3	90	48.1	57	30.5	**3.94**	1.043
18	9	4.8	9	4.8	26	13.9	92	49.2	51	27.3	**3.89**	1.016
19	13	7.0	4	2.1	21	11.2	86	46.0	63	33.7	**3.97**	1.080
20	10	5.3	3	1.6	25	13.4	92	49.2	57	30.5	**3.98**	0.994
21	6	3.2	11	5.9	34	18.2	81	43.3	55	29.4	**3.90**	0.997
22	8	4.3	9	4.8	31	16.6	88	47.1	51	27.3	**3.88**	1.004
23	9	4.8	6	3.2	26	13.9	92	49.2	54	28.9	**3.94**	0.996
24	7	3.7	11	5.9	28	15.0	85	45.5	56	29.9	**3.92**	1.010
25	7	3.7	9	4.8	32	17.1	87	46.5	52	27.8	**3.90**	0.987
26	9	4.8	6	3.2	44	23.5	88	47.1	40	21.4	**3.77**	0.981
27	9	4.8	9	4.8	23	12.3	98	52.4	48	25.7	**3.89**	1.000
28	8	4.3	9	4.8	29	15.5	96	51.3	45	24.1	**3.86**	0.979

Most mean results were very close to 4, which means that most pre-service teachers have a positive perception of their TPACK constructs. The means range between 3.63 and 4.17, and they both represent TK items. The lowest mean refers to item 4 “I frequently play around the technology” whereas the highest mean refers to item 2 “I can learn technology easily”, which also got the highest number of strongly agree responses. Item 5 “I know about a lot of different technologies” got the highest number of neither agree nor disagree responses, and item 19 “I

can choose technologies that enhance the teaching approaches for a lesson" got the highest number of strongly disagree responses.

Table 14 below summarizes the average mean per construct. All the means were very close to agree. The lowest mean was for TK, and the highest one was for CK.

Table 14. Pre-service teachers' TPACK mean per construct

TPACK Construct	Mean
TK	3.85
CK	3.95
PK	3.94
PCK	3.94
TCK	3.89
TPK	3.90
TPACK	3.86

As for the models of TPACK, pre-service teachers agree that their education professors (item 29) were the most ones who appropriately modelled combining content, technologies, and teaching approaches in their teaching, followed by their professors outside of education (item 30). As for the cooperating teachers, pre-service teachers were closer to neutral in regarding them as models of TPACK (item 31).

Table 15 below shows the detailed results of pre-service teachers' models of TPACK.

Table 15. Pre-service teachers' results of Models of TPACK

	Strongly Disagree		Disagree		Neither Agree nor Disagree		Agree		Strongly Agree		Mean	Std. Deviation
Code	**1**		**2**		**3**		**4**		**5**			
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**		
29	12	6.4	6	3.2	32	17.1	101	54.0	36	19.3	**3.76**	1.010
30	7	3.7	10	5.3	65	34.8	82	43.9	23	12.3	**3.56**	0.910
31	10	5.3	15	8.0	73	39.0	68	36.4	21	11.2	**3.40**	0.975

Concerning the percentage of teachers who were models of TPACK, two-thirds of pre-service teachers believe that more than half of their education professors have provided an effective model of TPACK. Moreover, almost half of the pre-service teachers believe that more than half of their professors outside of education and the cooperating teachers were effective models of TPACK.

Table 16 below shows the detailed results of the percentages of the effective models of TPACK as perceived by pre-service teachers.

Table 16. Pre-service teachers' results of Models of TPACK percentages

	25% or less		**26% - 50%**		**51% - 75%**		**76%-100%**			
Code	**1**		**2**		**3**		**4**		**Mean**	**Std. Deviation**
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**		
1	14	7.5	34	18.2	89	47.6	50	26.7	**2.94**	0.865
2	22	11.8	64	34.2	81	43.3	20	10.7	**2.53**	0.838
3	32	17.1	56	29.9	77	41.2	22	11.8	**2.48**	0.912

4.1.2 In-Service Teachers Questionnaire Results

Table 17 below displays the detailed results for in-service teachers' TPACK questionnaire. It shows the frequencies (N) and the percentages (%) of the whole sample of in-service teachers per TPACK item.

Table 17. In-service teachers' results of TPACK constructs

	Strongly Disagree		**Disagree**		**Neither Agree or Disagree**		**Agree**		**Strongly Agree**		**Mean**	**Std. Deviation**
Code	**1**		**2**		**3**		**4**		**5**			
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**		
1	-	-	3	5.8	6	11.5	29	55.8	14	26.9	**4.04**	0.791
2	2	3.8	-	-	1	1.9	23	44.2	26	50.0	**4.37**	0.864
3	2	3.8	-	-	8	15.4	22	42.3	20	38.5	**4.12**	0.943
4	-	-	2	3.8	14	26.9	23	44.2	13	25.0	**3.90**	0.823
5	1	1.9	1	1.9	6	11.5	30	57.7	14	26.9	**3.90**	0.913
6	2	3.8	2	3.8	6	11.5	25	48.1	17	32.7	**4.06**	0.802

7	2	3.8	2	3.8	9	17.3	26	50.0	13	25.0	**4.02**	0.980
8	2	3.8	2	3.8	2	3.8	29	55.8	17	32.7	**3.88**	0.963
9	2	3.8	1	1.9	4	7.7	24	46.2	21	40.4	**4.10**	0.934
10	1	1.9	2	3.8	3	5.8	26	50.0	20	38.5	**4.17**	0.944
11	1	1.9	2	3.8	3	5.8	31	59.6	15	28.8	**4.19**	0.864
12	1	1.9	2	3.8	3	5.8	31	59.6	15	28.8	**4.10**	0.823
13	1	1.9	3	5.8	3	5.8	22	42.3	23	44.2	**4.21**	0.936
14	1	1.9	3	5.8	4	7.7	22	42.3	22	42.3	**4.17**	0.944
15	2	3.8	2	3.8	6	11.5	24	46.2	18	34.6	**4.04**	0.989
16	1	1.9	3	5.8	4	7.7	25	48.1	19	36.5	**4.12**	0.922
17	1	1.9	3	5.8	3	5.8	28	53.8	17	32.7	**4.10**	0.891
18	1	1.9	2	3.8	3	5.8	32	61.5	14	26.9	**4.08**	0.813
19	1	1.9	2	3.8	7	13.5	29	55.8	13	25.0	**3.98**	0.852
20	1	1.9	2	3.8	7	13.5	27	51.9	15	28.8	**4.02**	0.874
21	2	3.8	4	7.7	9	17.3	25	48.1	12	23.1	**3.79**	1.016
22	2	3.8	2	3.8	13	25.0	22	42.3	13	25.0	**3.81**	0.991
23	1	1.9	3	5.8	7	13.5	25	48.1	16	30.8	**4.00**	0.929
24	1	1.9	4	7.7	6	11.5	29	55.8	12	23.1	**3.90**	0.913
25	1	1.9	3	5.8	8	15.4	25	48.1	15	28.8	**3.96**	0.928
26	1	1.9	1	1.9	14	26.9	24	46.2	12	23.1	**3.87**	0.864
27	2	3.8	1	1.9	8	15.4	26	50.0	15	28.8	**3.98**	0.939
28	2	3.8	2	3.8	8	15.4	26	50.0	14	26.9	**3.92**	0.967

Most mean results were very close to 4, which means that most in-service teachers have a positive perception of their TPACK constructs. The means range between 3.79 and 4.37. The lowest mean refers to item 21: “My teacher education program has caused me to think more deeply about how technology could influence the teaching approaches I use in my classroom” whereas the highest mean refers to item 2: “I can learn technology easily”, which also got the highest number of strongly agree responses. Item 4: “I frequently play around the technology” and item 26: “I can provide leadership in helping others to coordinate the use of content, technologies, and teaching approaches at my school and/or district” got the highest number of neither agree nor disagree responses.

Table 18 summarizes the average mean per construct. All the means were very close to agree. The lowest mean was for TPK and TPACK, and the highest one was for PK.

Table 18. In-service teachers' TPACK mean per construct

TPACK Construct	Mean
TK	4.06
CK	4
PK	4.14
PCK	4.1
TCK	4.08
TPK	3.92
TPACK	3.92

As for the models of TPACK, in-service teachers agree that their education professors (item 29) were the most ones who appropriately modeled combining content, technologies, and teaching approaches in their teaching, followed by their professors outside of education (item 30). As for the cooperating teachers, pre-service teachers were closer to neutral in regarding them as models of TPACK (item 31).

Table 19 below shows the detailed results of pre-service teachers' models of TPACK.

Table 19. In-service teachers' results of Models of TPACK

	Strongly Disagree		Disagree		Neither Agree or Disagree		Agree		Strongly Agree			
Code	**1**		**2**		**3**		**4**		**5**			
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**Mean**	**Std. Deviation**
29	2	3.8	3	5.8	10	19.2	25	48.1	12	23.1	**3.81**	0.991
30	2	3.8	3	5.8	19	36.5	19	36.5	9	17.3	**3.58**	0.977
31	2	3.8	7	13.5	18	34.6	19	36.5	6	11.5	**3.38**	0.993

Concerning the percentage of teachers who were models of TPACK, two-thirds of in-service teachers believe that more than half of their education professors have provided an effective model of TPACK. Moreover, almost half of the in-service teachers believe that more than half of their professors outside of education and the cooperating teachers were effective models of TPACK.

Table 20 shows the detailed results of the percentages of the effective models of TPACK as perceived by in-service teachers.

Table 20. In-service teachers' results of Models of TPACK percentages

	25% or less		26% - 50%		51% - 75%		76%-100%			
Code	**1**		**2**		**3**		**4**		**Mean**	**Std. Deviation**
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**		
1	3	5.8	9	17.3	26	50.0	14	26.9	**2.98**	0.828
2	7	13.5	17	32.7	18	34.6	10	19.2	**2.60**	0.955
3	8	15.4	17	32.7	22	42.3	5	9.6	**2.46**	0.874

4.1.3 Pre-Service Teachers vs. In-Service Teachers Questionnaire Results

As shown in table 21, both pre-service and in-service teachers had a positive perception of their TPACK level; however, in-service teachers had slightly higher means on all 7 constructs. The construct with the lowest mean was TK for pre-service teachers compared to TPK and TPACK for in-service teachers, whereas the construct with the highest mean was CK for pre-service teachers compared to PK for in-service teachers. In general, the constructs that included technology were the ones that got lower means for pre-service and in-service teachers. CK was also one of the constructs with lower means for in-service teachers; however, it was the one with the highest mean for pre-service teachers.

Table 21. Pre-service teachers vs. In-service teachers TPACK mean per construct

TPACK Construct	Pre-Service Teachers	In-Service Teachers
TK	3.85	4.06
CK	3.95	4
PK	3.94	4.14
PCK	3.94	4.1
TCK	3.89	4.08
TPK	3.90	3.92
TPACK	3.86	3.92

As for the models of TPACK, both had very close means, and both viewed their education professors as the ones who appropriately modeled combining content, technologies, and teaching approaches in their teaching, followed by their professors outside education and then their pre-K12 cooperating teachers (Table 22).

Table 22. Pre-service teachers vs. In-service teachers Models of TPACK

	Pre-Service Teachers	In-Service Teachers
1. Education professors	3.76	3.81
2. Professors outside Education	3.56	3.58
3. Pre-K12 cooperating teachers	3.4	3.38

As for the models of TPACK percentages, the same order applies, and both got close results (Table 23).

Table 23. Pre-service teachers vs. In-service teachers Models of TPACK percentages

	Pre-Service Teachers	In-Service Teachers
1. Education professors	2.94	2.98
2. Professors outside Education	2.53	2.6
3. Pre-K12 cooperating teachers	2.48	2.46

4.2 Document Analysis (Syllabi)

The syllabi of the undergraduate and graduate Education courses were analyzed to study the representation of the 7 TPACK constructs in the course outcomes of each of them.

4.2.1 Undergraduate Courses

As shown in table 24, technology was almost not represented in any undergraduate course. The only course that included technology in its outcome was the Educational Technology for Teachers course. Out of the four technology constructs, this course addressed TK and TPK only. Even the courses that aim at teaching subject matters like Math and Sciences (EDUC328, EDUC423) and Arabic (EDUC333) didn't address any technology construct, despite the fact that there are plenty of specialized applications and programs that make learning these subject matters easier and that teachers should learn so that they can use in their future teaching. On the other hand, all courses focused on content knowledge (CK), and some focused on PCK and PK.

Table 24. Representation of TPACK constructs in the course outcomes of undergraduate Education courses

Course Code	Course Name	TPACK Constructs in Education Course Outcomes						
		PK	CK	TK	PCK	TCK	TPK	TPACK
ENGL205	Introduction to English Literature	x	✓	x	x	x	x	x
ENGL220	Modern English Grammar	x	✓	x	x	x	x	x
ENGL231	Advanced English Grammar	x	✓	x	✓	x	x	x
ENGL260	Children Literature	x	✓	x	✓	x	x	x
ENGL300	Academic Writing	x	✓	x	x	x	x	x
ENGL360	Introduction to Linguistics	x	✓	x	x	x	x	x

ENGL400	Phonology	x	✓	x	✓	x	x	x
ENGL470	Advanced EFL Conversation	x	✓	x	✓	x	x	x
EDUC321	Teaching Oral Communication	x	✓	x	✓	x	x	x
EDUC367	Language Acquisition	x	✓	x	✓	x	x	x
EDUC405	Methods of Teaching and Testing	✓	✓	x	✓	x	x	x
EDIT 250	Educational Technology for Teachers	x	✓	✓	x	x	✓	x
EDUC221	Introduction to Educational Psychology	✓	✓	x	x	x	x	x
EDUC230	Teaching Arts and Crafts	x	✓	x	✓	x	x	x
EDUC250	Physical Education for K-3 Learners	✓	✓	x	x	x	x	x
EDUC261	Music Methods for Homeroom Teachers	x	✓	x	x	x	x	x
EDUC281	Learning and Developmental Theories	✓	✓	x	x	x	x	x
EDUC328	Introduction to Math and General Sciences Curriculum	✓	✓	x	✓	x	x	x
EDUC333	Methodology of Teaching Arabic	✓	✓	x	✓	x	x	x
EDUC346	Introduction to Classroom Management	✓	✓	x	x	x	x	x
EDUC347	Teaching of Reading	x	✓	x	✓	x	x	x
EDUC375	Introduction to Special Education	✓	✓	x	x	x	x	x
EDUC380	Statistical Research in Education	x	✓	x	x	x	x	x
EDUC411	Introduction to Philosophy of Education	x	✓	x	x	x	x	x
EDUC423	Teaching Mathematics and General Sciences for Elementary Teachers	x	✓	x	✓	x	x	x
EDUC440	Teaching Practicum I	✓	✓	x	x	x	x	x
EDUC460	Role of Play in Child Development	✓	✓	x	x	x	x	x
EDUC490	Teaching Practicum II	✓	✓	x	x	x	x	x
		11/28	**28/28**	**1/28**	**12/28**	**0/28**	**1/28**	**0/28**

Table 25 shows some examples of TPACK constructs as written in the syllabi of some undergraduate Education courses.

Table 25. Sample course outcomes for undergraduate Education courses

Course Code	Course Name	Sample Course Outcomes
ENGL231	Advanced English Grammar	CK: Identify the basic grammatical concepts PCK: Examine different strategies in teaching grammar.
ENGL260	Children Literature	PCK: Select appropriate literary materials that meet the personal and intellectual requirements and interests of individual children. PCK: Demonstrate the ability to select and present books and stories for the purpose of motivating children to enjoy literature and to become lifelong readers.
ENGL400	Phonology	CK: Identify the parts of the vocal tract and their roles in speech production PCK: Design a lesson plan to teach pronunciation
ENGL470	Advanced EFL Conversation	PCK: Apply language learning strategies to self and be able to teach to simplify to others.
EDUC321	Teaching Oral Communication	PCK: Identify ways to develop listening and public speaking skills and apply them in different settings. PCK: Design well-developed oral communication lesson plans integrating lessons with real life and different subjects and implement the plan through micro-teaching.
EDUC367	Language Acquisition	PCK: Compare/contrast language teaching approaches PCK: Devise a language teaching lesson using learned skills

EDUC405	Methods of Teaching & Testing	PK: Design an effective assessing system for students' achievement. PK: Construct lesson plans using different templates. PCK: Perform the appropriate teaching methods based on the taught subject.
EDIT 250	Educational Technology for Teachers	TPK: Identify effective technology tools and theories to improve teaching and learning TPK: Apply educational technology theories and tools effectively into the teaching and learning practices. TK: Create their own e-portfolio
EDUC221	Introduction to Educational Psychology	PK: Identify the key concepts and principles that guide teachers in their efforts to adapt instructions to students' cognitive abilities and promote their further cognitive development. PK: Recognize the importance of creating a student learning environment by catering for students' needs based on the theories on reinforcement, punishment and motivation.
EDUC230	Teaching Arts and Crafts	PCK: Assess the effectiveness of the use of their own art and crafts work and that of others for educational purposes
EDUC250	Physical Education for K - 3 Learners	PK: Plan individual and small-group activities and materials that promote the development of different skills.
EDUC281	Learning & Developmental Theories	PK: Examine different instructional strategies and motivational techniques
EDUC328	Introduction to Math and General Sciences Curriculum	PK: Design different test items with different levels according to Bloom's taxonomy. PCK: Generate a test item according to a certain given objective.
EDUC333	Methodology of Teaching Arabic	PK: Identify best practices of teaching children. PCK: Recognize different strategies for teaching pupils the Arabic language.
EDUC346	Introduction to Classroom Management	PK: Identify approaches to classroom management
EDUC347	Teaching of Reading	PCK: Identify methods of teaching reading for different grade levels. PCK: Design a lesson plan and implement it to teach reading.
EDUC375	Introduction to Special Education	PK: Select the most appropriate strategies to deal with each case.
EDUC423	Teaching Mathematics and General Sciences for Elementary Teachers	PCK: Design well-developed math and science lesson plans integrating lessons with real life and different subjects. PCK: Recognize and assess differences in students' thinking in math and science
EDUC440	Teaching Practicum I	PK: Compare and contrast between how a class should be managed and how the cooperating teacher is managing hers/his.
EDUC460	Role of Play in Child Development	PK: Explain the way play addresses the five areas of child development – physical, social, emotional, language, cognitive. PK: Explain the role of the teacher in creating a personalized learning environment that supports and motivates children to play.
EDUC490	Teaching Practicum II	PK: Compare and contrast best practices of teaching in the 21st century

4.2.2 Graduate Courses

Graduate Education courses barely addressed technology in their course outcomes. The only technology construct that was addressed in three courses, including the Educational Media and Technology course, is the TPK construct. All courses focused on content knowledge (CK), half focused on pedagogical knowledge (PK), and a few focused on pedagogical content knowledge (PCK).

Table 26. Representation of TPACK constructs in the course outcomes of graduate Education courses

Course Code	Course Name	TPACK Constructs in Education Course Outcomes						
		PK	**CK**	**TK**	**PCK**	**TCK**	**TPK**	**TPACK**
EDUC511	Classroom Dynamics	✓	✓	x	x	x	x	x
EDUC520	Philosophy of Education	x	✓	x	x	x	x	x
EDUC556	Advanced methods of Teaching Humanities and Language	✓	✓	x	x	x	x	x
EDUC557	Advanced Methods of Teaching Science and Math	✓	✓	x	✓	x	✓	x
EDUC561	Educational Media and Technology	x	✓	x	x	x	✓	x
EDUC565	Assessment and Evaluation	✓	✓	x	x	x	x	x
EDUC600	Curriculum Design and Evaluation	✓	✓	x	x	x	x	x
EDUC660	Teaching Practices	✓	✓	x	x	x	✓	x
EDUC667	Counseling: Theory and Practice	✓	✓	x	x	x	x	x
EDUC677	International Education Administration and Policy Analysis	x	✓	x	x	x	x	x
EDUC694	Graduate Research Project	x	✓	x	x	x	x	x
EDUC551	Research Methodology and Dissertation Preparation	x	✓	x	x	x	x	x
EDUC580	Practicum in Educational Management and Leadership	✓	✓	x	x	x	x	x
EDUC610	Applied Linguistics	x	✓	x	✓	x	x	x
EDUC631	Content Area Education for TESL Students	x	✓	x	✓	x	x	x
EDUC640	Strategic Planning in Education	x	✓	x	x	x	x	x
EDUC646	Literacy and Language development	✓	✓	x	✓	x	x	x
		9/17	**17/17**	**0/17**	**4/17**	**0/17**	**3/17**	**0/17**

Table 27 shows some examples of TPACK constructs as written in the syllabi of some graduate Education courses.

Table 27. Sample course outcomes for graduate Education courses

Course Code	Course Name	Sample Course Outcomes
EDUC511	Classroom Dynamics	PK: Design an engaging classroom environment conducive for learning. PK: Employ effective communication skills and strategies for dealing with students' misbehavior
EDUC556	Advanced methods of Teaching Humanities and Language	PK: Plan the instructions of a lesson by applying problem-based learning. PK: Conclude the effect of using different questioning strategies in class. PK: Design lesson plans that are long-term united and integrated.
EDUC557	Advanced Methods of Teaching Science and Math	TPK: Develop student-centered lesson plans supported by the use of technology. PCK: Adapt relevant learning experiences that promote effective science and math learning. PK: Determine the appropriate use of different kind of concepts' representations
EDUC561	Educational Media and Technology	TPK: Discuss the role and impact of technology in education TPK: Distinguish the learning theories that underpin the use of different educational technology tools TPK: Plan for technology integration that maximizes motivation, engagement, efficacy and efficiency with respect to learning

EDUC660	Teaching Practices	TPK: Integrate effective technology tools in teaching
EDUC667	Counseling: Theory and Practice	PK: Promote students' cooperation and team work. (pre-service teachers')
EDUC580	Practicum in Educational Management and Leadership	PK: Promote students' cooperation and team work. (pre-service teachers')
EDUC610	Applied Linguistics	PCK: Identify techniques of teaching new vocabulary and strategies of learning new lexis PCK: Utilize appropriate and varied language assessments
EDUC631	Content Area Education for TESL Students	PCK: Identify the different approaches used in CBLT (content-based language teaching) and how they differ from each other
EDUC646	Literacy and Language development	PCK: Design engaging activities to promote reading and writing PK: Use appropriate and varied instructional approaches for culturally and linguistically diverse learners

4.2.3 Undergraduate vs. Graduate Courses

When comparing both courses, we find that CK was represented in the course outcomes of all courses. The representation then drops greatly for PK, PCK, TPK, and TK. TCK and TPACK were not represented in any course outcomes.

The decreasing order of representation of TPACK constructs for all courses holistically is CK, PK, PCK, TPK, TK, and then TCK and TPACK.

Table 28. Total representation of TPACK constructs in the course outcomes of all Education courses

Course Name	TPACK Constructs in Education Course Outcomes						
	PK	**CK**	**TK**	**PCK**	**TCK**	**TPK**	**TPACK**
Undergraduate Courses	39.3%	100%	3.5%	42.9%	0%	3.5%	0%
Graduate Courses	52.9%	100%	0%	23.5%	0%	17.6%	0%
All Courses	44.4%	100%	2.2%	35.5%	0%	8.9%	0%

4.3 Interview Results

In this section, the interview results will be provided for the following topics: Technology competency, impediments/challenges, improvements/recommendations, best practices, and TEP preparation.

4.3.1 Technology Competency

One question that was asked to pre-service teachers, in-service teachers, and teacher educators was about their technology competency level and the tools and applications they are competent using.

a. Pre-Service Teachers

Table 29 shows the responses of pre-service teachers to the question about their technology competency level. The majority of undergraduate and graduate pre-service teachers believe

that they are competent using technology. Technology competency level is higher for graduate students, as 44.4% of them find themselves very competent using technology.

Table 29. Pre-service teachers' technology competency level

	Undergraduate Level Pre-Service Teachers (N)	Graduate Level Pre-Service Teachers (N)	%
Not competent	4.8%	5.6%	5.2%
Competent	61.9%	50%	54.4%
Very competent	33.3%	44.4%	40.4%

The tools and applications pre-service teachers believe they were good at are:

- Presentation apps: Microsoft PowerPoint, Google Slides, and Prezi
- Video conferencing apps: Zoom
- Assessment apps: Kahoot
- Online collaboration apps: Whiteboard
- Online learning platforms: Google Classroom and Microsoft Teams
- Social media apps: Facebook, WhatsApp, and Telegram
- Other apps: Microsoft Word, Google Sites, StoryboardThat, Screencast-O-Matic, and PhET Simulations

Some pre-service teachers have reported that they are not competent in using technology:

- *"I'm not competent in using technology. I am good when I am using google classroom."*

- *"When it comes to using technology, I feel that I'm not competent because the educational program in the Lebanese schools doesn't rely much on technology."*

While others have reported that they are competent in using technology. Some have referred that to self-development while others have referred it to the courses at the TEP:

- *"I consider myself competent when it comes to using technology, and I always try to train on that. I am good at using PowerPoint, Google Classroom, and Zoom meeting."*

- *"After studying more than one subject at the university that revolves around technology and how to use it in the field of education, I see myself that I have become qualified in this, as I have some experience in using Google Classroom, Zoom, Word, PowerPoint, Excel, Story Board, and many other programs."*

- *"As a teacher, I see myself competent in using technology because I have the technical skills every teacher should have and the adequate training from the educational courses. For example: word processing skills, electronic presentation skills....*

Most educators use a combination of tools to teach, including video, e-mail, desktop conferencing, online programs like WebCT and Blackboard, video conferencing, whiteboard and google classroom."

- *"In the field of technology, I'm competent. So here in my work I use word documents, excel sheets that help me prepare the lesson plan and the worksheet activity. I also use YouTube videos for the lesson discovery and as a tool for learning. I use power point in oder to prepare a social story."*

On the other hand, some pre-service teachers have mentioned that they are very competent in using technology. Some have referred that to the practical experience they got from teaching:

- *"I see that I'm very competent in using technological tools. I think that I'm competent in Google Classroom, Google Sites, Microsoft Word, Microsoft PowerPoint, and Screen Cast-O-Matic."*

- *" I'm very competent with using technology in classroom because the school I work for now mostly relies on technology for teaching, so I can say I'm competent with using Microsoft programs, smart boards in classes, Zoom, online platforms for schools where students upload their assignments and I assign assignments and so on."*

b. In-Service Teachers

Table 30 shows the responses of in-service teachers to the question about their technology competency level. Most in-service teachers believe that they are competent using technology, and around one-third believe that they are very competent.

Table 30. In-service teachers' technology competency level

	In-Service Teachers (N)	**%**
Not competent	1	5%
Competent	12	60%
Very competent	7	35%

The tools and applications in-service teachers believe they are good at are:

- Presentation apps: Microsoft PowerPoint, Google Slides, Prezi, and Nearpod
- Video conferencing apps: Zoom and Google Meet
- Assessment apps: Kahoot, Quizlet, Quizizz, Classmarker, Edpuzzle, and Google Forms
- Online collaboration apps: Trello, Padlet, Jamboard, and Flipgrid
- Online learning platforms: Google Classroom and Microsoft Teams
- Learning management systems: Seasaw, Madrasati, and Moodle
- Educational games: PECS app, KidsAZ, and Wordwall
- Photo and video editing apps: Adobe Photoshop, Adobe Illustrator, and Windows Movie

Maker
- Other apps: Microsoft Word, Microsoft Excel, Google Docs, Google Sheets, Screencast-O-Matic, PhET Simulations, Youtube Videos, Active Inspire, and Live Worksheets
- Electronic devices: Computers, LCD projectors, iPads, and Interactive Smartboards

Below are some quotes for in-service teachers' responses reflecting the varied competency levels.

- "*I am not competent, but I often use Word, Excel, and PowerPoint."*

- *"Digital learning is most often used in my classes competently. The simple tools I usually use are: Google Forms, videos, video games, interactive worksheets, PowerPoint, YouTube, Zoom, Microsoft Teams, Google Classroom and Madrasatie application…etc."*

- *"I feel very competent using technology because I feel that I'm qualified. I can use technology applications and softwares to engage my students during the lesson. As for the applications I'm competent with, they are PhET simulations, Nearpod, and Jamboard."*

c. Teacher Educators

Table 31 shows the responses of teacher educators to the question about their technology competency level. Most teacher educators believe that they are competent using technology. Very few believe that they are incompetent or very competent.

Table 31. Teacher Educators' technology competency level

	Teacher Educators (N)	**%**
Not competent	2	9.5%
Competent	18	85.7%
Very competent	1	4.8%

The tools and applications teacher educators believe they are good at are:

- Presentation apps: Microsoft PowerPoint, Google Slides, Prezi, Nearpod, and Mentimeter
- Video conferencing apps: Zoom, Google Meet, Skype, and WebEx
- Assessment apps: Kahoot, Quizlet, Edpuzzle, Google Forms, and Socrative
- Online collaboration apps: Padlet, Jamboard, and Voice Thread
- Online learning platforms: Google Classroom and Microsoft Teams
- Learning management systems: Moodle and eSchool
- Photo and video editing apps: Adobe Photoshop, Adobe Illustrator, Windows Movie Maker, and Canva

- Social media apps: Facebook, WhatsApp, and Twitter
- Other apps: Microsoft Word, Microsoft Excel, Google Docs, Google Sheets, Google Drive, Google Blogger, Google Calendar, StoryboardThat, Screencast-O-Matic, Bandicam, Youtube Videos, Video Podcasts, SPSS, and Jeopardy App
- Electronic devices: Computers, LCD projectors, Tablets, and Interactive Smartboards

As for teacher educators, most have reported that they are competent using technology. They at least know the basics, like Microsoft and the applications needed for online teaching.

- "I am not an expert in technology, yet I am able to use the basics that I need in order to stay connected and to run my classes. I use: laptop, phone, tablet, Google Classroom, Google Docs and Sheets, Zoom, social media platforms (Whatsapp, Facebook, Twitter), emails, slides, videos."

- "I have an average /general acceptable knowledge about technology; however, I lack some when it comes to specific usages and details. I am competent in using educational platforms like: Google Meet, Teams, Zoom, Moodle, and PowerPoint."

- "I consider myself competent in using technology. My first encounter in technology was with basic tools like Microsoft office applications. At the university I had some programming courses. During my work experience I had to go through several trainings like office 365 and all its applications, skills in teaching and learning online and skill in special programs like InDesign and illustrator."

- "I cannot assess myself, but I can say that I am very comfortable when it comes to integrating technology in my classes. Whenever I integrate any tool, I always set a purpose. I always ask myself:
a. Why do I want to use it? What value does it add to my lesson?
b. Would it interest students? Would it help them achieve the learning objective?
I'm competent with Google Forms, Edpuzzle, Kahoot, Padlet, Screencast-O-Matic, and Google Classroom."

Two teacher educators have perceived themselves as very competent using technology. One has referred that to self-development, while the other has referred it to his passion for technology.

- "I am very competent and when there is something that is new or did not know about, I like to learn it and use it in my classes. Some of the tools are: Google Classroom, Google Forms, Google Slides, Google Meet, Zoom, VoiceThread, Jamboard, Quizlet, YouTube and Canvas."

- "I personally would describe myself as someone who is highly competent with the use of technology, as technology has always been part of my life ever since I was a child. So, I found technology to be something very useful and I was able to adapt to technology and to the ever

going and continuous updates that occur in different technologies. Personally, I'm quite familiar with the use of different communication apps, the use of emails, design software, editing software, some music software, of course, the use of social media and of course the use of basic program site for example Microsoft office."

d. Comparison of Technology Competency Level

Table 32 compares the technology competency level as reported by the three participant groups: pre-service teachers, in-service teachers, and teacher educators.

Table 32. Technology competency level comparison

	Pre-Service Teachers (N)	In-Service Teachers (N)	Teacher Educators (N)
Not competent	5.2%	5%	9.5%
Competent	54.4%	60%	85.7%
Very competent	40.4%	35%	4.8%

In the three participant groups, the percentage of those who didn't believe they were competent using technology was very low. On the other hand, the percentage of those who believed they were competent was the highest in the three groups. Teacher educators got the highest percentage of "competent" level, whereas pre-service teachers got the highest percentage of "very competent" level.

4.3.2 Impediments

Pre-service teachers, in-service teachers, teacher educators and administrators were asked about the impediments faced when integrating technology into teaching. The reported barriers (table 33) were sorted into four themes: impediments at the national level, institutional level, teacher level, and student level. The most common barriers were the weak infrastructure at the national level, lack or limited resources at the institutional level, and the lack or limited technological knowledge and skills at both the teacher and student level.

Table 33. Impediments for integrating technology in teaching

		Pre-Service Teachers	In-Service Teachers	Teacher Educators	Administrators	Total
National Level	Lack of or weak infrastructure (Electricity & Internet)	44	12	18	4	**78**
Institutional Level	Lack of or limited resources	13	10	9	4	**36**
	Curriculum	2	1	4	-	**7**
	Lack of technical support	2	2	2	1	**7**

	Lack of adequate professional development	-	-	1	-	**1**
Teacher Level	Lack of or limited technological knowledge and skills	9	2	5	5	**21**
	Financial difficulties	6	-	1	1	**8**
	Lack of time/Workload	1	-	2	2	**5**
	TPK difficulties	2	1	1	1	**5**
	Lack of will to learn or to integrate technology	-	-	-	2	**2**
	Age	1	-	-	-	**1**
Student Level	Lack of or limited technological knowledge and skills	6	1	8	-	**15**
	Lack of or limited resources	4	3	5	1	**13**
	Attitude towards technology	3	-	4	1	**8**

a. Impediments at the National Level

At the national level, participants mentioned the lack of or the weak infrastructure (electricity and Internet connection) as a major impediment. This problem got worse due to the economic crisis that Lebanon has been passing through since 2019. Because of this crisis, the Lebanese government went bankrupt and wasn't able to pay for the imported fuel. The major facilities have lost their ability to secure people with electricity and Internet. As a result, students and teachers faced real problems charging their electronic devices and connecting to the internet, which is already very weak and poor.

These impediments were evidently clear in the participants' responses to the interview question about the barriers to integrating technology. As shown below, the most commonly quoted barrier by all participant groups was the lack of electricity and the weak internet connection.

- *"Currently, I have not tried the method of teaching using technology, but I think that the obstacles that I may face are the weak Internet in Lebanon, in addition to the significant lack of electricity." (Pre-service teacher)*

- *"Unfortunately, being in Lebanon isn't that easy! Integrating technology in teaching may be somehow complicated due to internet connection problems and the electricity cutoffs." (Pre-service teacher)*

- *"Usually in Lebanon all we have a common electricity and internet connection problems and unprepared classes for technology." (Pre-service teacher)*

- *"The most difficult barrier we face is the lack of internet and electricity, whether at school or with students." (In-service teacher)*

- "The barriers that I face to integrate technology in teaching at my school are the electricity and the weakness of Internet in our country." (In-service teacher)

- "In Lebanon nowadays, there are many barriers that prevent teachers from using technology. The most important one is electricity which is not available most of the time. Second barrier is that half of the students have no internet any more at their houses." (In-service teacher)

- "Another problem I think is the traditional Lebanese problem which is electricity shortage." (Teacher educator)
- "In addition to the technical stuff, we have a bad internet connection in Lebanon and power cuts. That also stop many students from using technology and some teachers as well." (Teacher educator)

- "Definitely since we're staying in Lebanon and living in Lebanon, the first barrier is electricity, internet connectivity, and having or owning an old computer and being unable to get a new one." (Teacher educator)

- "Because we live in Lebanon, we have an issue with the Internet and with electricity, and these are major impediments and we have the financial crisis." (Administrator)

- "The implementation of technology cannot always be feasible due to access constraints related to poor internet connection and electricity shortage in Lebanon." (Administrator)

b. Impediments at the Institutional Level

At the institutional level, the most common reported impediment was the lack of or limited resources at the academic institution, like laptops, computer labs, LCD projectors, smartboards, and subscriptions to educational apps and websites. Another barrier was the curriculum. The teacher participants complained about the condensed curriculum, whether at university or at schools, that hinders them from integrating technology and being creative. What they care about is finishing the curriculum on time. Moreover, some said that they are afraid to use technology because it may waste their time and keep them behind in the curriculum. Other impediments were the lack of technical support from the IT department and the lack of adequate professional development.

As can be concluded from the below quotes, participants' main complaints were about the lack of resources at university and at schools. Most classes are not equipped with even the basics, like computers and projectors, that were bought by some teachers with their own money.

- "We don't have enough material to make the use of technology easier. Very little schools have prepared classes to use technology as smart whiteboards for example or tablets." (Pre-service teacher)

- "The lack of material; for example, I myself have bought a projector and subscribed for

Prezi." (Pre-service teacher)

- "The first barrier is the lack of infrastructure preparation in schools. I personally teach in a public school. We have 2 old overhead projectors for at least 40 different classes." (Pre-service teacher)

- "Also, the schools are not well technologically equipped as to laptops and computers. We normally bring our own laptops." (In-service teacher)

- "One of the barriers that we face to integrate technology in teaching at our school is that interactive whiteboards are not available in our classes." (In-service teacher)

- "We find difficulties in that we cannot secure a computer or tablet inside the kindergarten." (In-service teacher)

- "Lack of computers, the speed of computers, and internet signal problems." (In-service teacher)

- "Lack of resources is the first barrier that I encounter when trying to integrate technology into teaching. As an instructor, I feel impeded by the lack of white smart boards in my classrooms. Some classrooms don't even have an overhead projector, so I need to borrow and carry one around when I have a teaching session." (Teacher educator)

- "Not having access to different websites that require subscription." (Teacher educator)

- "Using technology in the classroom doesn't come without some drawbacks. Some classes might not have the necessary equipment. (Teacher educator)

- "The barriers are mostly the lack of the required infrastructure. Many times, even when I want to use the minimum which is a PPT presentation, I cannot find an LCD because not all classes are equipped with an LCD. Sometimes, there is an LCD but my computer does not connect to it and I cannot find the right port to do that. The lack of internet connection in our classes also limits our options and prevents us from doing much more when it comes to adding technology to our teaching and learning activities. Not having institutional subscription to some online applications like Kahoot is an additional barrier to integrating technology." (Teacher educator)

- "The building lacks some basic requirements for integrating technology into learning. For example, there are no built-in projectors in classes. Instead, an educator has to ask for a portable projector from the administration, use it, then return it, which is all time-consuming." (Administrator)

Other participants have complained about the lack of time and the tight curriculum that make

teachers feel reluctant about integrating technology in order not to waste time and catch up with the curriculum.

- *"Class duration and the curriculum. For instance, the session duration at schools is like 35 to 40 minutes, and we need time to set up the laptop and projector for every session and this consumes time. Also, as teachers, we have to follow the time required for every lesson as indicated on the curriculum, and this may let me not use technology in order not to lose time and be able to finish the lesson within the time required by the school." (Pre-service teacher)*

- *"Mostly time is the biggest barrier. With an overcrowded curriculum and schedule there won't be enough time to perform all the activities fully." (In-service teacher)*

- *"Time constraints and the curriculum requirements. We don't teach for mastery we just need to finish the curriculum." (Teacher educator)*

- *"Material development is time consuming, and using technology in the classroom, if not well planned, eats up class time. If students are asked to use their smart phones to complete certain activities, they might get distracted." (Teacher educator)*

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- *"Weekly schedule in the syllabus did not allow much space for innovation. We focused on covering information more than actually applying it." (Teacher educator)*

Moreover, other complaints regarding technology integration were related to the lack of technical support and professional development.

- *"Also, lack of resources and access to technical support." (In-service teacher)*

- *"At the institutional level, there are budget constraints. As a result, there is a lack of resources and technical support." (Administrator)*

- *"Having said that, if all the resources are available, I would say that some professional development for teachers is needed to implement technology in teaching." (Teacher educator)*

c. Impediments at the Teacher Level

At the teacher level, most participants have mentioned the lack of or limited technological knowledge and skills of teachers. Another barrier was the teachers' financial difficulties, which impeded them from buying technological tools or services. Teachers also lack the time to prepare for technology integration due to their workload. Moreover, some teachers who are proficient with technology face problems using it in teaching (TPK). They don't know how or when to use it. Some others find difficulty managing the students and the whole class while

using technology. Another barrier at the teacher level was that some teachers are unwilling to spend time to learn more about technology, and some are old.

As shown below, the most common barrier quoted by participants at the teacher level was the lack of or limited technological knowledge and skills. Some have referred that to the lack of experience or the lack of practice.

- *"The barrier to integrate technology in teaching is that I am unfamiliar with using technology in the classroom, as I have a little experience as a teacher and tutor which didn't require using technology." (Pre-service teacher)*

- *"We didn't do a lot of practice on technology programs, so sometimes I forget the main concept of the program or how to use it." (Pre-service teacher)*

- *"The main barrier is that I lack some basic technology skills like how to send files, save information..." (Pre-service teacher)*

- *"I think I don't know much about all the tools to integrate technology in education. I would like to have training course for them." (Pre-service teacher)*

- *"As teachers, we all understand the importance of technology in the classroom. However, there is still a large group of teachers who either feel like they don't know where to begin, have never learned this technology, or feel overwhelmed by it." (In-service teacher)*

Other participants were really concerned about teachers' lack of knowledge related to the pedagogy of using technology. This includes knowledge related to classroom management, time management, and lesson delivery strategies while integrating technology.

- *"I don't have enough skills yet, and the thing that worries me the most is not being able to manage the class properly." (Pre-service teacher)*

- *"I am afraid of having difficulty facilitating the explanation or not being able to get students to understand the lesson while using technology. Also, I don't feel like I have enough ability not to waste time using technology. The barrier is that I don't think that I am sufficiently skilled in using technology in a very precise way during explanation." (Pre-service teacher)*

- *"Some of the barriers that I used to face is not being able to know when to use technology. For example, when I was to teach reading, should I have students listen to an audio or present the reading selection on screen or let students watch a video… like when it is best to integrate technology in grammar, reading, writing, speaking, and even in assessments." (In-service teacher)*

- *"Some instructors are not adequately proficient in using technology. Many of those who are proficient in technology use do not know how to use it to adequately transform the learning experience." (Administrator)*

In addition to the lack of technological skills and the pedagogy of using technology, some participants have quoted the lack of time as an impediment. So, planning and preparing for technology integration would add more work to teachers who are already overloaded with the different tasks they have at hand.

- *"The barriers we are facing as teachers is adding more and more work to our teaching. So, in addition to the paper and pencil material we usually prepare, now we have to prepare material using educational technology tools like creating online interactive sheets in addition to the paper sheets we usually prepare." (Pre-service teacher)*

- *"The barriers that I face to integrate technology in teaching is when I misuse technology due to the lack of advanced skills. Moreover, it is time consuming because I lack some technical skills and work on an old laptop." (Teacher educator)*

- *"Instructors do not have enough time to plan for effective technology integration. Others lack expertise with technology skills." (Administrator)*

In addition, some other participants have quoted financial difficulties, lack of will, and teachers' age as impediments.

- *"The only barrier I might face as a teacher is of course the internet and the cost if I want to subscribe to more proficient tools maybe." (Pre-service teacher)*

- *"Sometimes instructors on their own are not willing to go the extra step for integrating technology. It could be that it's difficult for them, it's new, it's time consuming because they have to learn different things when they want to integrate technology. Plus, sometimes when you want to let's say work on yourself to learn new things, this takes time and effort and it has a financial burden on the instructor." (Administrator)*

- *"Some of the old teachers are unable to integrate technology in their classes effectively." (Pre-service teacher)*

d. Impediments at the Student Level

At the student level, participants have mentioned that some barriers are that students lack the required technological knowledge and skills and lack access to technological resources. Students also have an attitude towards the use of technology.

The most commonly quoted impediment at the student level was the lack of or limited technological skills, which make it difficult for teachers to easily integrate technology.

- *"The most important problem is with the students who lack technology skills and face problems using computers." (In-service teacher)*

- *"Some other barriers can include sometimes the students themselves when some students might be incompetent with the use of technology or sometimes the students themselves don't want to learn or to adapt to new technologies." (Teacher educator)*

- *"Students lack the knowledge and the expertise to using technology." (Teacher educator)*

Another major barrier quoted at the student level was their attitude towards technology. They either don't have the will or don't take it seriously because they believe that technology is for entertainment only.

- *"I expect the main barrier I might face is the familiarity of students with these technologies. Students in Lebanon especially do not take it seriously when it comes to teaching through technology at class or even online classes, and that's because of the mentality firstly and because of the internet and connection issues in the second place." (Pre-service teacher)*

- *"Not everyone has an equal culture towards technology. To solve this issue, students must be given some lessons related to technology, even if they are not within the curriculum." (Pre-service teacher)*

- *"One barrier is in some students' understanding of using technology. They are convinced that technology is only used for entertaining purposes and not for education." (In-service teacher)*

- *"Students' attitudes towards technology is another barrier. The thing is they might not have internet or computer access. Some students are demotivated when it comes to using technology. It is their mindset. They are not used to it. They just prefer the traditional way of teaching." (Teacher educator)*

- *"One of the main barriers might be the students' misconception of the purpose of technology, that is, not viewing it as an educational tool." (Teacher educator)*

- *"Students sometimes even lack the will to learn something new and to try something new. Sometimes, you feel that students are resistant to learning about a new application or trying to use something new. When I use Padlet, students would start complaining about it and ask if they can do the work instead on a regular word document. So, this resistance to change and learning something new is one of the biggest barriers that a teacher can face when she wants*

to integrate something new into her classes, let alone something related to technology." (Teacher educator)

The lack of or limited resources was another barrier at the student level. Students don't have equal access to technology.

- *"Some barriers are: Not enough computer labs on campus; slow/lack of internet connection; economic problems in the country; the inability of all students to have equal access to technology in order to experience learning (those from middle- and low-income backgrounds do not have this access); and the inadequate knowledge and skills of some instructors." (Administrator)*

4.3.3 Improvements

To promote technology integration in the TEP, the four participant groups have provided some recommendations (table 34). The most common recommendation was to make changes to the teaching and learning process at the TEP. This was followed by a request to provide professional development and training for both teachers and students, make some changes to the Education curriculum, facilitate access to technological resources, motivate teachers and students to use technology, promote innovation and creativity in the TEP, and recruit specialized people.

Table 34. Recommendations for promoting technology integration in the TEP

	Pre-Service Teachers	In-Service Teachers	Teacher Educators	Administrators	Total
Recruitment	-	-	1	4	**5**
Access to resources	5	7	16	3	**31**
Curriculum	25	6	5	-	**36**
Teaching and learning process	34	21	7	-	**62**
Innovation and creativity	8	3	2	3	**16**
Motivation and support	5	3	2	8	**18**
Professional development and training	16	7	18	4	**45**

a. Recruitment

Administrators mostly and one teacher educator have recommended recruiting IT personnel and establishing an IT department at each campus to help teacher educators and pre-service teachers integrate technology into their teaching. They have also recommended recruiting technology-proficient teacher educators who can integrate technology into their classes and who can also help their colleagues in this process. This was reflected in the participants' quotes below.

- "Make qualified IT personnel available in bigger numbers and unified vision." (Teacher educator)

- "Recruit technology-adept instructors and identify dedicated personnel who are ready to devote time and effort for technology integration, serve as peer mentors, and write grant proposals for technology. The institution must offer release time and incentives for those instructors." (Administrator)

- "We should establish an IT division at each campus that will support instructors and students in their digital learning." (Administrator)

b. Access to Resources

Mostly, teacher educators have recommended having some access to resources. As mentioned in the below quotes, some of these resources include access to speedy Wi-Fi, smartboards, overhead projectors, licensed platforms, websites that require subscriptions, language labs, and E-libraries.

- "Strengthen the wifi coverage and speed at university, so students won't have any excuses in not being able to do their assignments or projects." (Teacher educator)

- "Providing sufficient resources and equipment in each and every classroom like smartboards, overhead projectors, and Wifi to ensure connectivity access." (Teacher educator)

- "Instructors to be given access to reliable resources and licensed platforms." (Teacher educator)

- "As for the department, what we actually need are resources, training for instructors, and access to websites." (Teacher educator)

- "I think we should also upgrade the infrastructure at university like having for example language labs where we have up to date and fast computers, headphones, speakers and all of these tools that would help us to add more technology into our classes and teaching of English." (Teacher educator)

- "Universities should always have online databases for teachers and students to search for credible resources. Having an e-library is important specially for education students. (Teacher educator)

- "Subscribe in certain paid platforms. Sometimes you also need access to some equipment." (Administrator)

c. Curriculum

Participants have recommended adding more educational technology courses, adding a course that teaches advanced educational technology skills and applications, adding more practical courses rather than the theoretical ones where students can apply the technological skills they have learnt, dividing the educational technology course into levels since not all students have the same technological competency, integrating technology in all education courses and not limiting it to educational technology courses, reducing courses that are not directly related to education, adding a practicum course specialized in teaching technology integration rather than teaching methods, and allowing first year students to take the practicum course instead of having them wait until the third year, as this will prepare them to have a real life example of the teaching experience and expectations. Participants have also suggested revisiting the TEP syllabi to leave room for technology integration.

Below are some participants' quotes related to the abovementioned suggestions about courses.

- *"We can make changes in the curriculum; we can reduce the courses that are not so important and essential." (Pre-service teacher)*

- *"Teacher education program should contain different courses about integrating technology in teaching in addition to the theoretical education system." (Pre-service teacher)*

- *"Increasing educational technology courses and creating training courses where students can apply the skills they were taught." (Pre-service teacher)*

- *"They should integrate technology in all education courses, and they should add one more educational technology course in addition to the one already there." (Pre-service teacher)*

- *"I believe that the course Educational Media and Technology is more than enough, but maybe if there is a more advanced course on how to use video making and editing programs and making animes or tutorials in education. I would like to know more of interesting tools to implement in my teaching later on." (Pre-service teacher)*

- *"Technology course could be made into levels, for the purpose of breaking down the process and considering that not all students are of the same technological background or have the same experience with online tools and apps." (Pre-service teacher)*

- *"More educational technology courses should be given for students so they will be more professional in using technology. Encourage teachers to use technology. Maybe practicum courses that focus on technology beside practicum courses that focus on ways of teaching." (In-service teacher)*

- *"The program should start with allowing the students to do Practicum 1 at the first year, because it will allow them to observe the class, students and teachers which will give them a*

better idea about what they will learn and how to improve their teaching practices." (In-service teacher)

- *"I know that students at the TEP take an educational technology course, but I think it is not enough. I think we need to add another course that introduces students to the wide universe of educational tools and apps that we have now. We need to train the students to design assessment tools, activities, and games using educational technology tools." (Teacher educator)*

As mentioned earlier, some curriculum recommendations were related to changes to be made for the syllabus, and this was quoted in the below responses.

- *"Instructors and decision makers (coordinators, dean, directors) should revisit the course syllabi and plan effective integration of technology." (Teacher educator)*

- *"Syllabus needs to be updated. It should be designed in a way to leave room for the use of technology." (Teacher educator)*

- *"I also recommend that we invest in training our teachers; we invest in modifying our curriculum in the sense that it could be more open to multiple methods of assessment like let's integrate e-porfolios, and let's integrate videos prepared by the students." (Teacher educator)*

d. Teaching and Learning Process

Participants have also made some suggestions to promote technology integration during the teaching and learning process. These recommendations include having technology integrated by all teacher educators and mentor teachers since they act as role models, varying the applications used by each teacher educator, so that students are exposed to as many applications as possible during their university years, teaching about applications used for students with special needs to promote inclusion, providing pre-service teachers with several opportunities to practice technology integration themselves, giving assignments, projects, and activities where pre-service teachers have to use technology, and providing pre-service teachers with feedback about their performance when integrating technology.

As stated above, some participants have suggested that all teacher educators and mentor teachers integrate technology, as this will provide pre-service teachers with more exposure to technology integration.

- *"Integrating technology by our instructors would be an efficient way to help us integrate technology as well. In that case, we would be perceiving those tools from the students'*

perspective and therefore we would know which tools to use and when and what areas to enhance." (Pre-service teacher)

- "We need to see how technology is being integrated at schools during our practicum." (Pre-service teacher)

- "Since instructors are role models, they should use technology while teaching us because we learn from them." (In-service teacher)

- "Since most schools nowadays are mainly using technology, it is important that 90% of the courses at the education program help teachers integrate technology. For instance, in the courses like teaching of reading, grammar, writing…, I suggest instructors to teach future teachers on when/when not to integrate technology and in what part of the curriculum." (In-service teacher)

Other participants have stressed the importance of exposing pre-service teachers to different tools by different teacher educators, and this was quoted in the below responses.

- "Each instructor can use a specific and new application different from the rest of the instructors while giving us his course, and therefore we as students learn about more than one application and learn how to use it instead of using the same applications in all courses." (Pre-service teacher)

- "We should learn more about new technologies for special education, the assertive technology that helps students with educational disabilities to be able to join others and many other technologies that encourage schools to have inclusive education. These tools make inclusion more effective and easier." (Pre-service teacher)

- "Instructors should use different kinds of tools first by teaching about the tool, and then explaining the lesson using that tool." (In-service teacher)

In addition, some other participants have quoted the importance of providing pre-service teachers with ample opportunities to practice technology integration, apply what they have learned, do technology-related assignments, and get feedback about their technology delivery.

- "I think we need only to practice technology more. Students should be obliged to use and apply the tools and applications they learned in the educational technology course in other education courses as this will help students practice these tools more and be competent in using them." (Pre-service teacher)

- "Future teachers should be prepared well by some media and technology courses and workshops. They should also apply what is learned in many other courses. Every skill when

practiced in more than one course or field will result in a highly qualified teacher. In addition, future teachers should be followed up by all what they need to learn concerning these skills. They can practice these skills in a homework, projects, and extracurricular activities." (Pre-service teacher)

- *"I would like to hear from my instructors some notes about my performance as a teacher using technology at the classroom." (Pre-service teacher)*

- *"Ask pre-service teachers to prepare a lesson plan based on the integration of technology in the 2 phases of explanation and assessment. Ask them to present so everyone will benefit."* (In-service teacher)

e. Innovation and Creativity

To promote technology integration, participants have suggested launching competitions for innovative ideas in educational technology and having a team of experts from the TEP who is specialized in coming up with novel and innovative ideas related to the use of technology in education. This was reflected in the below respondents' quotes.

- *"I would recommend launching educational technology competitions with prizes for innovative ideas and practices." (Teacher educator)*

- *"Creating a team of technology experts in the department who work on always integrating novelties and encourage innovation in the use of technology in education." (Administrator)*

- *"We should work more on making our digital learning more student-centered, more creative and collaborative." (Administrator)*

f. Motivation and Support

Some recommendations here were providing pre-service teachers and teacher educators with advice and motivation to improve their technical skills and always use technology, and providing those with limited technology competency with some special help and support. Another recommendation was getting the support of upper management and sharing the success stories of teacher educators who successfully integrated technology in their classrooms.

As shown in the below quotes, support to develop technological skills and integrate technology was frequently mentioned.

- *"Give us advice and encouragement to be strong and capable in a very easy way to always use technology." (Pre-service teacher)*

- *"The university should provide special help and support to education students who don't know how to use technology. For instance, when I first started at the university, I didn't know how to send an email and suffered with using technology, but I got acquainted with that later on." (Pre-service teacher)*

- *"The first step is to help (through explanations/observations/ real experiences…) the teachers to be ready (reconsider) to integrate technology in their classrooms. In other words, to help them believe in themselves and take the decision to abandon the traditional way of teaching and start integrating technology in their classrooms as well." (In-service teacher)*

- *"We should keep motivating both students and instructors to improve their technical skills and competences in order to become digitally active." (Administrator)*

- *"You need the support of upper management if you want to properly integrate technology into any program. It's like the hierarchy at the institution needs to provide the proper support. So starting from the upper administration, into the personnel that actually provide the support to the instructors and then to the students." (Pre-service teacher)*

Sharing success stories was also quoted as a suggestion to promote technology integration.

- *"Also, administrators can share success stories where an educator successfully integrated technology into his/her course." (Pre-service teacher)*

g. Professional Development and Training

Participants have suggested organizing workshops for pre-service teachers and teacher educators. From these workshops, teacher educators can learn how to integrate technology into their teaching, so that pre-service teachers can learn that by modeling. They also suggested organizing on-going trainings that graduates can join to stay up-to-date with all the strategies and applications pertaining to technology integration in education. Another suggestion was getting expert guest speakers to talk about the latest innovations in technology integration. This was reflected in the below quotes.

- *"Give free workshops for education instructors on how to properly integrate technology in the teaching process in the classroom. In this way, they can demonstrate the proper ways to integrate technology in their classrooms and we as students can learn from them." (Pre-service teacher)*

- *"I think we should be up to date with every educational tool and program. It's not enough to teach us some and then graduate. Every year there should be training sessions in progress to better use of technological tools and applications." (Pre-service teacher)*

- "As graduate students from university and for new students, we need to have intensive lectures more about the new programs that are required from us as teachers, especially after the introduction of online learning in the Corona stage, where we had to use a lot of new programs and modern platforms to communicate with students and teachers." (In-service teacher)

- "Professional development by providing workshops about different tools that can be integrated in teaching. Also, provide opportunities to learn from peers in terms of how to effectively integrate technology and build confidence in and exploring benefits of using ICT." (Teacher educator)

- "The school of education should do many workshops specially for instructors who are not that competent in using technology or new updates. Also, the IT department can work on facilities like seminars/ webinars or any tutorials that can help students and instructors. Finally, have expert guest speakers every now and then talking about the latest updates and softwares where students will be engaged and excited to listen and participate." (Teacher educator)

- "Educators, as well as students, should be provided with professional development related to technology." (Administrator)

4.3.4 Best Practices

Pre-service teachers and in-service teachers were asked about the best practices that they have observed from their Education instructors during their study period at the TEP and that they have found helpful to prepare them to integrate technology in their future teaching. Teacher educators were also asked about their opinion on the best practices for integrating technology into teaching.

Participants have listed several useful uses for technology in education. They have mentioned that technology can be helpful in:

- Lesson and project presentation using Microsoft PowerPoint, Google Slides, Prezi, Pear Deck, and Nearpod
- Storytelling using storyboardThat. Participants believe that this tool helps in conveying ideas in a simple, easy, and entertaining way.
- Course content presentation and portfolio creation using Google Sites
- Recorded lesson explanations and tutorials using Screencast-O-Matic
- Interactive displays during a lesson delivery using ActiveInspire
- Mind map creation using MindMup
- Icebreakers and poll design using Mentimeter
- Educational video content using YouTube and MasterClass
- Worksheet preparation using englishwsheets.com

- Assessment using Kahoot, Socrative, Quizizz, Quizlet, and Google Forms. Google Docs was also mentioned as a useful assessment tool especially that it has the plagiarism check option.
- Online collaboration using Whiteboard, Padlet, and Jamboard
- Online learning using Google Classroom and Microsoft Teams
- Learning management using Edmodo
- Time and event management using Google Calendar
- Video conferencing using Zoom and Google Meet

Teacher educators have also highlighted the importance of technology in peer evaluation and flipped classrooms, in facilitating project-based learning, attending webinars, targeting different learning styles, differentiating instruction, and engaging students.

Below are some quotes from pre-service teachers' responses to the question about the best practices they have witnessed to integrate technology during their TEP:

- *"Teacher educators mostly used PowerPoint to present the material, and sometimes they used YouTube to show us videos and they prepared the exams through Google Classroom by using Google Form and Google Docs. I feel I can use these tools in my future career because they can help me to teach and present my lessons. Then, I think I can benefit from using the storyboard to create storytelling for my KG students after I have learned how to use it."*

- *"The teachers have used many programs and means for the purpose of education, but there are some programs that were my favorite and I will certainly use them in teaching in the future. The means are Portfolio, which contributes a lot to organizing the method of education and also the storyboard, which helps to convey the idea in a simplified, easy, and entertaining way at the same time."*

- *"Several programs were used by my instructors especially those that are specialized for lesson planning. How to design a lesson plan, how to introduce lessons digitally by adding PowerPoints, adding links from the webs, recording our voices on a lecture and how to design quizzes using Google Forms."*

- *"I found that Google Sites is the greatest program that will be helpful in my future teaching since it features putting everything I want. It also features arranging each section to make using it easier, like creating a section for reading, another for grammar, and another for videos...etc."*

- *"I've learned from my instructors some educational tools that can engage students in their learning process such as Edpuzzle where a video can illustrate a certain concept while at the same time a teacher can help students focus by asking many questions while watching the video. In addition to Edpuzzle, there is Google Classroom, Google Forms, Google Sheets, and Google Docs that are also useful."*

- "There are many programs learned from professors and suitable for evaluating students and at the same time to entertain students. Such as: Kahoot, Quizizz, and Socrative. After a course or unit, educational apps like Kahoot can be utilized in the classroom to review content. Teachers can collaborate on Kahoots and share them with their colleagues, while students can use anonymous user names to play the game. This permits students who are generally reluctant to participate in class to participate in a whole-class activity."

As for in-service teachers, they have mentioned that:

- "Our instructors often used some programs like Excel, Word, PowerPoint, and Google Docs. These are the programs I use now during my teaching."

- "Some instructors were integrating technology by using apps like Google Classroom and Edmodo. Learning how to use these apps was very helpful because through it I was able to learn new similar applications easily."

- "The most useful program was PowerPoint. Really, we can use it in preparing the lesson, dividing its parts into slides using different images and videos. Moreover, we can include voice notes recorded by us or by others. Furthermore, it helped us in the era of covid-19 in online teaching, while we can use let's say: webinar program and include this PowerPoint lesson in it."

- "Using google classroom was helpful especially during online learning. In addition, Google Forms for quizzes helped me assess students as much as I can during the year since grades are given on the spot. Also, preparing a whole lesson using slideshows, videos, adding links, pictures and worksheets at any time of the day."

- "Amongst teacher practices that influenced me a lot and was helpful was using Jamboard during the session and MindMapping and discussion board on google classroom."

- "Teacher educator practices that were given to students by teachers and that I decided to implement in my teaching are the following websites: Ted Talks, Master Class, and englishwsheets.com. I think that all modern teachers need to know about these online resources to support their teaching."

As for teacher educators, they have mentioned that:

- "We can use word processing, forms, PowerPoint, Prezi, mind mapping and all types of advanced organizers. For example:
1- prepare a lesson plan on a Word doc
2- prepare the lesson presentation on a PowerPoint

3- start the session with a placement test on Google Forms
4- use the PowerPoint for instructions
5- use Kahoot to test understanding
6- summarize the lesson using concept mapping or any advanced organizer
7- evaluate using Google Forms
8- distribute assignments with rubric using Google Classroom
9- send a video for next time as a flipped classroom
10- ask students to evaluate peers via Google Form (rubric) in Google Classroom."

- "Some examples for good practices of technology integration for students are for example: I used to let them create their own online portfolios as a means to be more organized and more knowledgeable in using technology specially for Practicum courses. Students also used to create and use media like blogs, podcasts, activities and slides. Finally, project-based activities incorporating technology like creating games or diagrams or including a PowerPoint presentation or a short description video."

- "The best practices to integrate technology in teaching are using:
- Zoom, Google Meet, and Microsoft Teams where an instructor can break out rooms for students to work in groups.
- Project-based activities that incorporate technology, such as developing digital stories.
- One-on-one video calls if need be.
- Group video calls
- Attending webinars
- Feedback and assessments
- Recording screencasts for providing onscreen instruction
- Synchronous and asynchronous activities
- Show students how they will apply what they are learning through online live sessions. For example, in one of my education courses, I show my students how they can develop a story on a power point by inserting their hand made illustrations as a slide background and typing their text on it, then converting the PowerPoint to a pdf to have a digital story as a final product."

- "I would say that Google Classroom is one of the best tools that we can use to integrate technology in our teaching. Also, I've been using quizlet in giving Education or English lessons such as grammar, and it has proven to be an interesting tool where students can practice the knowledge in addition to competing around the concepts of that knowledge. Quizizz is also a good tool."

- "I usually use Google Forms to assess students' prerequisite skills.
- I resort to YouTube to select videos that relate to the teaching objectives (Sprouts). Students have a set of questions to answer while watching the video ; this is achieved by using Edpuzzle.
- I use Kahoot at the end of the lesson as an assessment tool.
- Padlet is very helpful when students are asked to give reflections.
- When I want students to prepare the lesson before the session, I use screencast-o-matic to prepare a PowerPoint presentation with a voice over.

- Sometimes I come across readily available interactive online quizzes, which I assign for students as self assessment.
- I sometimes prepare my own storyboards, especially for education courses.
- I use the built-in feature in Google Classroom, originality report, to check for plagiarism."

- "Some of the best practices are using break out rooms if the class is given online, and watching YouTube speeches and asking students to pair up and evaluate."

- "I think Padlet is an interesting platform that can be used where students can share their opinion and some information with their friends about a certain topic or question that I would post there and they would reply to it. It looks like a board full of postit notes and every student can add their own postit notes."

4.3.5 TEP Preparation

To study whether the TEP at this Lebanese university is preparing pre-service teachers to integrate technology in their future teaching, participants have been asked several questions. For instance, pre-service teachers have been asked directly about whether the TEP is preparing them to integrate technology and whether they feel ready to effectively implement technology in their future teaching. In-service teachers were also asked about the degree to which the TEP has prepared them to integrate technology in their teaching and about their frequency of technology integration. As for teacher educators, they were asked about their perception of the role that technology plays in teaching and about their frequency of technology integration. On the other hand, administrators were asked about the degree to which technology is being integrated at the different levels and courses in the TEP, the university's rules and guidelines concerning technology integration, and the ways they follow to promote technology integration at the TEP.

a. Pre-Service Teachers' Perception

About two-thirds of undergraduate and graduate pre-service teachers believe that the TEP is preparing or has prepared them to integrate technology in teaching, compared to 14.3% of undergraduates and 12.1% of graduate pre-service teachers who believe that the program hasn't prepared them to integrate technology. The rest believe that the program has not completely prepared them for this integration (table 35).

Table 35. Pre-service teachers' perception of the degree the TEP has prepared them to integrate technology

	Pre-Service Teachers Undergraduate (%)	**Pre-Service Teachers Graduate (%)**
Yes, the TEP has prepared me	76.2%	75.8%
The TEP has somehow prepared me	9.5%	12.1%
No, the TEP hasn't prepared me	14.3%	12.1%

As for their readiness to integrate technology, more than 80% of undergraduate and graduate pre-service teachers believe that they are ready to integrate technology in teaching, compared to 14.3% of undergraduates and 11.4% of graduate preservice teachers who believe that they are not ready to integrate technology. The rest believe that they are somehow ready for this step (table 36).

Table 36. Pre-service teachers' readiness to integrate technology in their future teaching

	Pre-Service Teachers Undergraduate (%)	**Pre-Service Teachers Graduate (%)**
Yes, I am ready	81%	85.7%
I'm somehow ready	4.7%	2.9%
No, I'm not ready	14.3%	11.4%

Below are some excerpts of pre-service teachers' responses to the question about TEP preparation for technology integration and their readiness for this step:

- *"Yes, the program is preparing me to integrate technology, and I feel ready to integrate technology in my future teaching. TEP is working on the effective teaching processes by engaging teachers with new technological skills."*

- *"The TEP doesn't prepare us as teachers for the future teaching. I can effectively implement technology in my teaching, and this is due to self-development and the workshops I attend on my own and not due to the TEP."*

- *"The educational technology course offered at university was very useful to me, but we need to practice more in order to master the applications being taught during this course. I don't find myself ready to integrate technology in my future teaching."*

b. In-Service Teachers' Perception

As for in-service teachers, half of them believe that the TEP has prepared them to integrate technology into their teaching, whereas 25% believe that the TEP has somehow prepared them, and 25% believe that the TEP has not prepared them for this integration (table 37).

Table 37. In-service teachers' perception of the degree the TEP has prepared them to integrate technology

	In-service Teachers (%)
Yes, the TEP has prepared me	50%
The TEP has somehow prepared me	25%
No, the TEP hasn't prepared me	25%

Below are some excerpts of in-service teachers' responses to the question about TEP preparation for technology integration:

- *"I've learned how to use technology from my instructors throughout the years. They would integrate technology in most of their classes during explanation. The Educational Technology course has also helped me get on how to integrate technology in my teaching, what applications to use, and how to use them. Not to mention that I did practice using these applications during projects and assessments which better helped me master the skill."*

- *"The TEP has somehow prepared me to integrate technology. I learned a lot of programs that help me integrate technology into teaching."*

- *"The teaching program gave me an idea about how important is it to use technology in my lessons; however, it didn't give me the technical resources to use in my lesson. It was only limited to MS Office."*

- *"It honestly didn't prepare me to the current situation that we're passing through. They did show us how to integrate technology but they focused on applications that are a bit more traditional. Applications like word documents, excel sheets, and PowerPoints are basic tools that we already know and use daily. However, as a 21st century teacher, it's not enough to only learn about these applications."*

- *"We had only one technology course, which was not effective at all. I search and learn about educational technology on my own."*

The greatest percentage (41.2%) of in-service teachers have reported that they integrate technology in their teaching almost always, 35.3% sometimes, and 23.5 always. None has mentioned that he never integrates technology into his teaching (table 38).

Table 38. In-service teachers' frequency of technology integration

	In-Service Teachers (%)
Always	23.5%
Almost always	41.2%
Sometimes	35.3%
Never	0%

The majority of in-service teachers (64.7%) have also reported that they use technology in all aspects of the teaching process (explanation, practice, assessment, etc.); 29.4% use it only while explaining the lesson; and 5.9% use it to make students practice the lesson explained (table 39).

Table 39. In-service teachers' aspects of technology integration

	In-Service Teachers (%)
All aspects	64.7%
Explanation only	29.4%
Practice only	5.9%

In this regard, in-service teachers have mentioned that:

- *"I use technology in education daily and in most of my classes, whether online or in person. It accompanies me in explaining the lesson, evaluating the students and supporting the lessons with activities."*

- *"Almost every day mainly for explanation whether online or face to face."*

- *"I often integrate technology in my teaching, at least twice a week, and mainly in the process of explanation."*

- *"I integrate technology approximately every day in my teaching while explaining a lesson, assessing my students, and giving them homework."*

c. Teacher Educators' Perception

For teacher educators to integrate technology into their teaching, it is essential that they have a positive perception of the role it plays in education. All interviewed teacher educators have agreed that technology plays a positive role in the teaching-learning process and that it can't be ignored nowadays. Some teacher educators have stressed the point that, despite the importance of technology, it remains a facilitator rather than the main player in the teaching and learning process. Others have mentioned that technology integration should be considered in all course syllabi and that teachers nowadays who are not competent in technology lack the skills that help them perform their tasks to the fullest.

Below are some excerpts of teacher educators' perceptions of the role of technology:

- *"Technology plays an integral role in teaching and can't be avoided especially after the pandemic."*

- *"I think we're heading more towards a world that is completely taken by technology and education will be part of that world. So, I think this is a very huge step and this is going to change education as we know it, and I believe that education in like 5 or 6 years from now will not be the same education we knew 5 or 6 years ago."*

- "Technology is a facilitator and not the main player in the teaching-learning process. We can't rely on it completely."

- "Integration of technology in today's classroom is part and parcel of any course syllabus. It's one of the teacher's duties to graduate students who are comfortable with and competent in using technology and who are internet and computer savvy. It is a needed skill and one of the 21st century skills to succeed in the work field."

- "Technology is similar to literacy. A teacher who isn't competent in using technology is lacking skills and is unable to perform his duty properly."

Moreover, they have mentioned that technology helps both teachers and students in all age groups and learning levels. It helps in differentiating the instruction, providing extra support for those who need extra help, facilitating personalized learning, and catering for different learning styles. Moreover, teacher educators have said that technology is important for distance and blended learning and that it eliminates barriers to education like time and space.

- "It is enjoyable by many students. Furthermore, it is effective in all age groups and learning levels."

- "Technology allows for differentiation in various ways (learning styles, higher-order thinking skills, etc.). It also plays a vital role in differentiating instruction to cater for students who need extra support."

- "Using technology can tailor different types of learning styles among learners where we can project videos, graphs, audios, games, apps, and others."

- "It helps students also study at their own pace, for both high achievers and underachievers."

- "It eliminates the barriers to education imposed by space and time. Students can take control of their learning."

Teacher educators have added that technology helps teachers in planning, material development, explanation, concept and lesson delivery, assignments, practice, assessment, grading, keeping record of students' work and progress, and communicating with students. It simply saves teachers a lot of time and provides them with a bank of activities and resources to resort to for future classes.

- "Technology can play an important role in education by providing tools and materials that can be used in the various stages of the teaching process. While planning instruction, the teacher needs to choose the material that can be used to reach the set objective; technology provides a variety of materials that satisfy this need."

- *"In a physical classroom, technology helps to engage students and assists teachers in delivering the concepts. Add to that the educational resources that are made available for teachers and students. Technology saves class time."*

- *"Technology enhances both the teaching process and the learning experience. I believe it allows teachers to expand on information, provide varied input, present visuals and authentic examples, boost critical thinking, and keep record of student work and progress. It ensures that all students are engaged (in polls, forms, games, etc.) and allows differentiation in various ways (learning styles, higher-order thinking skills, etc.). It also facilitates grading, by having automatic systems and by reading typed, instead of handwritten, answers."*

- *"It helps teachers in material development, both as course content and assessment. Also, teachers can use it as a means of motivating students and intriguing their interest in the subject which in return helps in information retention."*

Teacher educators have also mentioned that technology helps students practice what they have learned and enhances their cooperation, engagement, creativity, motivation, and critical thinking.

- *"The effective use of technology in classrooms can increase student engagement, help teachers improve their lesson plans, and facilitate personalized learning. It also helps students build essential 21st-century skills."*

- *"In this digital era, it is no doubt that technology plays a vital role in the teaching-learning process. When technology is applied in any educational setting, I believe that it supports students' motivation, knowledge, and learning. Students become more engaged and start to take control over their own learning. Thoughtful and effective technology integration into the classroom changes the classroom dynamics."*

- *"Using technology in the classroom undoubtedly engages students, so this contributes to having a vibrant classroom where students play an active role in the learning process, which leads to enhanced students' productivity."*

As for their frequency of technology integration, the greatest percentage (60%) of teacher educators have reported that they integrate technology in their teaching always, 33.3% sometimes, and 6.7 almost always. None has mentioned that he never integrates technology into his teaching (table 40).

Table 40. Teacher educators' frequency of technology integration

	Teacher Educators (%)
Always	60%
Almost always	6.7%
Sometimes	33.3%
Never	0%

The majority of teacher educators (81%) have also reported that they use technology in all aspects of the teaching process (explanation, practice, assessment, etc.), and the rest (19%) use it only while explaining the lesson (table 41).

Table 41. Teacher educators' aspects of technology integration

	Teacher Educators (%)
All aspects	81%
Explanation only	19%

In this regard, teacher educators have mentioned that:

- *"I consider myself someone who's highly competent with the use of technology. I try to integrate technology as much as possible or always. Whenever I have the chance to introduce my students to new technologies, new software, new websites, or new tools that they can use, I always make sure to never miss this chance, either by introducing this to them or by making them use this piece of technology. Mainly, I use it a lot in explanation. I rely a lot on technology in explanation and also in assessment as well and in practice."*

- *"I integrate technology in all my facets of learning and teaching. I start the class with a video or an online activity then a PowerPoint presentation with class discussion oral or on a Google document. I use technology with assessment and with assignments received and returned with remarks."*

- *"I use technology every time. I use different types of technology in the classroom, including virtual classrooms, PowerPoints, videos, homework assignments, online grading, etc…"*

d. Administrators

Administrators were asked about the degree to which they believe technology is being integrated at the TEP, the rules and guidelines imposed on teacher educators regarding technology integration, and the means they provide to support technology integration at the TEP.

To start with, administrators have agreed that in face-to-face teaching, the degree or frequency of technology integration is left to the teacher educator, and this definitely depends on his proficiency and innovation in using technology. They have reported that:

- *"In face to face classrooms the degree of integrating of technology is left for the teacher."*

- *"The integration of technology depends on the proficiency of the instructor and how innovative the instructor is in using technology in their classes."*

- *"Before going online, technology was only integrated for purposes of enhancing the understanding of various parts of the content. It was also widely used for communication and only a little bit for collaboration. Only a few courses chose to integrate online resources and/or platforms in the learning process."*

As for the rules and guidelines, administrators have mentioned that there are no rules imposed on teacher educators when it comes to the use of technology. Technology was mainly integrated into educational technology courses.

- *"When it comes to the use of technology in face to face classrooms, there are no communicated guidelines and rules except as to make sure that whatever is being used and how it is usd doesn't violate the general university's protocol and guidelines."*

- *"In face-to-face classes, the Education program didn't impose the use of technology. Some teachers who were updated as to the use of technology have integrated technology in their classes. But the majority of instructors didn't integrate technology unless they were teaching education technology course."*

- *"Before we went online, there were no specific rules or guidelines related to integrating technology in instruction. The integration of technology was indirectly encouraged through training provided to teacher educators in using technology like the training workshop on how to use Google Classroom and Google Suite."*

Finally, to support technology integration at the TEP, administrators have reported that they mainly provide training for their teacher educators, and that course coordinators are always there to help instructors who are not very competent in using technology.

- *"First of all, we support technology integration by training our faculty both on campus and online. Instructors attend seminars, workshops, webinars, and online conferences. Some course coordinators/leaders and instructors prepare and share tutorial videos and guidelines on using technological tools and applications."*

- *"In some cases, coordinators have provided step-by-step guidance and mentoring to colleagues with low proficiency in technological use. In brief, while the personal guidance and*

support has been very good, the equipment and technological resources are very basic and limited."

- "The upper personnel that are in charge such as the chair and the coordinators those who offer support to the teachers are really skilled in the integration of technology. The university has not provided any equipment for the instructors to use to integrate technology. We used to have online training to instructors to help them become better skilled in the integration of technology."

Chapter 5: Analysis and Discussion

This chapter reviews the findings and analyzes them in the context of the studies that were considered in Chapter 2. The study results will be analyzed and presented as per the research question. Thus, it will be divided into five parts: TPACK perceptions, impediments, recommendations, best practices, and TEP preparation.

5.1 Research Question 1: TPACK Perception

The first research question in this study is: What are the participants' perceptions of their own TPACK level? Three participant groups were targeted here, and they are pre-service teachers, in-service teachers, and teacher educators.

5.1.1 Pre-Service Teachers' TPACK Perception

In general, pre-service teachers perceived themselves as skilled and knowledgeable across all seven TPACK constructs. These results are similar to those presented by several studies in the literature where pre-service teachers showed a positive perception towards TPACK (Farjon et al., 2019; Isler & Yildirim, 2018; Redmond & Lock, 2019). Moreover, Koh et al. (2010) have examined the TPACK perception of 1185 Singaporean pre-service teachers and found that they rated slightly above average for each TPACK factor. Qiu et al. (2022) studied the TPACK of 286 pre-service teachers of Chinese as a second language and found out that they were slightly satisfied with their overall TPACK. As for Dong et al. (2015), they studied the TPACK of 390 pre-service teachers who have scored above average in all seven constructs.

The collective data for TK show that a high percentage of pre-service teachers perceive themselves as having a strong foundation in technical skills and are confident in their ability to navigate, solve, and learn about new technologies. As for CK, pre-service teachers believe that they demonstrate substantial knowledge in their primary teaching subjects. They not only believe that they understand their subject matter but also believe that they have multiple strategies to deepen their understanding and can use their subject as a cognitive tool. Moreover, they perceive themselves as having strong pedagogical skills (PK). They are confident in their assessment capabilities, can adapt their teaching to diverse student needs, and are familiar with student misconceptions. They also feel equipped with classroom management skills. As for PCK, the majority of pre-service teachers believe that they can select effective teaching strategies for their primary teaching subject, indicating an intersection of their understanding of subject content and effective teaching methods. The majority also believes that they know about effective technologies for their primary teaching subject, indicating an intersection of their technological skills and their understanding of subject content (TCK). In addition, a significant portion of pre-service teachers are confident in their ability to combine technology with pedagogical practices (TPK). They believe they can select, adapt, and integrate technologies into their teaching approaches and even envision taking on leadership roles in this domain. This demonstrates their capability to align technology seamlessly with their teaching methods. Finally, a high percentage of pre-service teachers feel competent in blending their primary subject, technologies, and teaching strategies (TPACK). This indicates a strong

overarching understanding of how content, pedagogy, and technology can be integrated for an effective teaching-learning experience.

However, when we compare the average means, we find that pre-service teachers' most positive perception was towards CK, PK, and PCK. This could be due to the fact that pre-service teachers' pedagogical strategies and subject content are still fresh in their minds since they are still in their training phase. This positive perception decreases slightly when technology is introduced (TPK, TCK, TPACK, and TK consecutively). This could be due to the TEP's curriculum, which emphasizes pedagogy and content over technology, and this was obvious in the results of the syllabi analysis. CK, PK, and PCK got the highest representation in the syllabi of both undergraduate and graduate education courses. However, when technology was introduced, the representation in the syllabi dropped greatly for TPK and TK and was completely absent for TCK and TPACK. Another reason why technology constructs got slightly lower scores could be because of pre-service teachers' comfort level with technology. It seems that pre-service teachers are not getting enough opportunities to practice technology integration themselves and are getting little hands-on experience and application with the various educational technologies, whether during their education courses or during their practicum experience at schools. This was made clear during the interviews, when many pre-service teachers recommended adding more practical technology courses instead of the theoretical ones. They also recommended providing them with several opportunities to practice technology integration themselves by assigning them different projects and assignments in this regard. Moreover, these results are also supported by the administrators' responses to the question about whether there are any rules or guidelines imposed by the Education Department on teacher educators to integrate technology in their teaching. All interviewed assistant deans and chairs said that there are no rules in this regard and that it is left to the instructor to choose whether to use technology or not. Moreover, around 25% of pre-service teachers found that less than half of their teacher educators were good models of TPACK integration, which reflects the fact that technology wasn't fully integrated across all education courses by all instructors. Moreover, around half of the pre-service teachers found that less than half of their educators outside education and less than half of the coordinating teachers at school were good models of technology integration. As a result, pre-service teachers are not fully exposed to technology integration during their TEP. Another reason why technology constructs have a lower representation could be the rapid technological advancements. With the shift to online learning that was made during the pandemic, too many new applications and tools were developed, which made it difficult for pre-service teachers to catch up.

Other studies showed a different order for the TPACK constructs. For example, in the study of Dong et al. (2015), TPK was rated as the construct with the highest perception for pre-service teachers and was followed by PK, PCK, TK, TCK, TPACK, and CK consecutively. Qiu et al. (2022) have found out that pre-service teachers were least confident in their TK. As for Saltan and Arslan (2017), TPACK construct was the one with lowest confidence for pre-service teachers.

In conclusion, the TPACK questionnaire results show that pre-service teachers had positive perceptions towards the seven TPACK constructs, with the technology components getting slightly lower scores. However, in the interview, most pre-service teachers perceived themselves as competent or highly competent using technology. This could be further problematized by the syllabi analysis results, which show that pre-service teachers' academic development is not their only and main source of confidence. The content, or what they are being taught, is not the most important thing to make them confident. It is how they are being taught, and this was reflected in the results of the second section of the questionnaire about the models of TPACK. The majority of pre-service teachers believe that their education teacher educators were good models of technology integration. This was supported by the answers of teacher educators to the question about their technology competency, where most of them believed that they were competent. Moreover, when asked about the tools and applications they are competent in using, pre-service teachers mentioned the same tools that were used by teacher educators during the teaching process. Pre-service teachers saw how these tools are used in teaching, which boosted their confidence in using technology in their future teaching. However, since not all teacher educators and coordinating teachers are integrating technology, and since pre-service teachers are not getting ample chances to integrate technology themselves, the technology constructs got lower scores.

5.1.2 In-Service Teachers' TPACK Perception

In-service teachers showcase remarkable positive perceptions across the TPACK constructs, and this goes in alignment with other studies like Dong et al. (2015). They appear to believe that they have not only foundational knowledge but also the skills to interlink these domains effectively. They perceive themselves as highly proficient in handling technology, and the majority of them believe that they have a good grasp over various technological facets (TK). They also feel that they have adequate knowledge and various strategies for their primary teaching subjects, with the added ability to use their subject as a cognitive tool (CK). They believe they have the ability to assess, adapt, and maintain classroom management and are adept at tailoring their approach to individual student needs (PK). Also, the majority of in-service teachers feel that they can effectively intertwine their teaching strategies with their subject content, indicating a deep understanding of how to make the subject matter more engaging and comprehensible (PCK). Moreover, they feel confident in blending technology with their primary teaching subject, ensuring that the content is delivered in a more enriched manner (TCK). As for TPK, they feel adept at incorporating technology into their teaching approaches. Whether it's about selecting, adapting, or integrating technologies, they believe that they exhibit a holistic ability to unify technological tools with their pedagogical methods. Finally, a high percentage of in-service teachers feel comfortable combining their primary subject, technologies, and teaching methodologies (TPACK), indicating an all-encompassing capability to deliver enriched teaching experiences.

In-service teachers' highest scores were for PK and PCK. This could be due to several reasons, like experience, ongoing professional development, reflection and iteration, peer interaction and collaboration, and direct feedback from students and coordinators. First, in-

service teachers have had good practical and hands-on classroom experience, which helps them refine their pedagogical skills, understand the nuances of teaching specific content, and develop strategies tailored to their students' needs. Second, schools usually provide in-service teachers with continuous professional development opportunities, which may include seminars and workshops that emphasize the latest updates on teaching strategies and technologies. Third, after every year of teaching, in-service teachers get the chance to reflect on what worked and what didn't work in their teaching. Consequently, this cycle of teaching, reflecting, and adjusting can help in attaining effective pedagogical skills and content delivery. Moreover, being in a school setting surrounded by teachers provides the chance to observe other teachers or just be exposed to discussions about challenges and strategies, which in the end would enrich the sense of PK and PCK. In addition, in-service teachers, over time, usually get implicit and explicit feedback from their students. They also receive feedback from their coordinators, which mostly considers pedagogical skills. This feedback would help in-service teachers adjust their strategies to better meet their students' learning needs.

In-service teachers' perceptions to their PK and PCK are also higher than any technology construct. This could be, as reported in the interview, due to the lack of or the weak internet connection, the lack of or the limited technological resources like laptops, computers, and LCD projectors, and the limited access to technical support at the schools where they teach. In-service teachers have also reported that one barrier they face to integrate technology is time and the condensed curriculum. Others said that they feel overwhelmed when using technology. As a result, in-service teachers may refrain from using technology in an attempt to save time, finish the curriculum as scheduled, and manage their stress levels while at the same time concentrating on how to deliver the content and manage their classroom.

As for TPK, one reason why it got a lower perception than TK and TCK could be because of what they have learned about technology during the study years at the TEP. Although TPK was more common in the course outcomes of the current education course syllabi, it seems that little emphasis at that time was dedicated to teaching the pedagogy of technology integration. For instance, during the interview, one in-service teacher suggested that teacher educators teach future teachers when, why, and how to integrate technology in more creative ways in the curriculum. This answer reflects that the current in-service teachers didn't get enough chances to explore TPK. Another reason could be the ease of adoption. Some technological tools are made to be simple and user-friendly and are thus easily incorporated into content without the need for much training, which increases TK and TCK scores. However, it may be more difficult and require deeper reflection and experience to effectively use technology to transform pedagogical practices, which affect TPK.

Another point to note is that in-service teachers' CK perception is lower than most other constructs. One reason could be, as mentioned earlier, the ongoing professional development that focuses mostly on pedagogy and technology rather than on updating or deepening content knowledge. Moreover, in-service teachers may become more comfortable with certain topics after teaching them for several years and thus might not feel that they are in need of broadening their CK. They may believe that now it is more important to focus on how to teach this content

or how to integrate technology into their teaching. As a result, their CK remains stable or may even decrease relative to other skills like PK, PCK, TCK, and TK. Another reason could be the dynamic nature of the subject matter taught. To illustrate, some subjects like sciences are advancing quickly, so in-service teachers' CK may become outdated if they do not keep up with the latest developments in their field of teaching. The curriculum constraints and the use of curricular material could also lead to lower CK. For instance, in-service teachers are usually required to adhere to a particular curriculum; thus, the depth or breath of the content they explore may occasionally be constrained by this. In addition, in-service teachers may rely on high-quality and comprehensive textbooks and other curricular resources that may eliminate their need to deepen their own content understanding (CK). Consequently, their knowledge may be extensive in some areas but may not cover the entirety of their subject. The schools' push for teachers to integrate technology in their teaching might also lead to increased TK and TCK compared to CK. Another reason could be the grade levels and the subject matters taught. In other words, in-service teachers who teach secondary grades are usually specialized in one subject matter; however, those who teach lower grades usually teach multiple subject matters, which makes it difficult for them to have deep CK in every subject. As shown previously in the general information of the interview's in-service participants, most in-service teachers teach lower grade levels, and many of them teach more than one subject matter.

The study of Dong et al. (2015) has yielded the same highest and lowest perceptions for in-service teachers; however, the order of the constructs was different. For instance, the highest perception was for PK, followed by TK, TCK, TPK, PCK, CK, and TPACK consecutively. Saltan and Arslan (2017) have found that in-service teachers' lowest confidence was for TK.

5.1.3 Pre-Service Teachers' vs In-Service Teachers' TPACK Perception

In-service teachers' questionnaire scores show an overall higher level of confidence across the seven TPACK constructs compared to pre-service teachers. These results are similar to other studies (Dong et al., 2015; Qiu et al., 2022). The highest difference was for TK, PK, TCK, and PCK consecutively, whereas the lowest difference was for TPK, CK, and TPACK. This could be attributed to several reasons, like experience and practical application of knowledge, feedback mechanisms, exposure to diverse classroom scenarios, adaptability, maturity, and confidence, and ongoing professional development. As mentioned earlier, in-service teachers' real-world teaching experience and practical application of knowledge help them reach a refined understanding of the subject matter's content knowledge, the teaching process, and the nuances of technology integration in the classroom, thus enriching their depth of understanding, the thing that may not be offered in theoretical learning. Second, since in-service teachers are teaching in real classrooms, this allows them to self-reflect and to receive feedback from their students, peers, and mentors. This cycle of teaching, reflecting, and then adjusting helps them identify the areas of strength and the areas that need improvement. Once these points are identified, in-service teachers will be in a loop of continuous improvement of their skills. Third, in-service teachers deal with a wide range of classroom circumstances over time, including various student behaviors, access to technology, curricular changes, and more.

Thus, they may have access to a wider range of tactics and knowledge as a result of this exposure. Fourth, in-service teachers are frequently at the forefront of integrating new technologies into their classrooms as educational technology advances. This was clear in the responses of pre-service and in-service teachers to the interview question about the tools they feel confident using. In-service teachers have provided a wider variety and more specialized applications compared to pre-service teachers. Thus, in-service teachers' ongoing adaptation can lead to a deeper grasp of technology and how it interacts with pedagogy and content. Moreover, age and work experience can both contribute to maturity, which can boost one's self-confidence. The results of in-service teachers' self-assessment tests may reflect this confidence. Finally, in-service teachers have access to continuous professional development programs, which help them, over the years, accumulate their exposure and training for the best teaching practices, thus increasing their confidence and capability for all TPACK constructs.

5.1.4 Teacher Educators' Perception to their Technology Competency

Although they haven't been assessed using the TPACK questionnaire, teacher educators' interviews reveal that they have a thorough awareness of various technological tools and that they know at least the basics of running their classes. As reported by teacher educators during the interview, this could be explained by the technology-related courses they have taken during their Bachelor or graduate studies, which helped them become competent. Others depended on self-learning, as one teacher educator has reported that if there is anything new about technology that he didn't know about or that was new, he would learn about it on his own and use it in his classroom. Others have said that their competency is due to their work experience and the workshops they have attended, whether at the university under study or at other educational institutions where they work. This point is supported by the administrators' responses to the question about the steps taken to support technology integration at the TEP. They all agreed on the point that they do provide on-campus and on-line training for their faculty. This includes seminars, workshops, webinars, and online conferences. They also reported that course coordinators and leaders, who are skilled in technology integration, provide teacher educators with tutorial videos and guidelines on using technological tools and applications. They also provide teacher educators with step-by-step guidance and mentoring to faculty with low proficiency in the use of technology. Finally, because of COVID-19 and the lockdown, teaching became online, so teacher educators found themselves obliged to learn more about technology and to remain updated with the latest tools and methods to maintain their teaching positions.

It is worth mentioning that most teacher educators' responses to the question about their technology competency were directed to their technology knowledge (TK). Only one teacher educator has clearly responded to this question from a TPK viewpoint when he said that whenever he integrates technology, he sets a purpose and asks himself about why he wants to use it, what value it will add to the lesson, whether it will interest students and thus improves their engagement, and whether it will help them attain the learning objectives of the lesson. Another teacher educator, when asked about the barriers to integrating technology, has mentioned that he lacks the pedagogy for using technology. His answer was also reflected in

one administrator's response to the same question when he said that some teacher educators who are proficient in technology use do not know how to use it to adequately transform the learning experience (TPK).

Several studies in the literature about teacher educators have yielded similar results. For instance, Góktaş et al. (2009) found that teacher educators' perceived ICT competency was completely sufficient. However, in the study conducted by Carpenter et al. (2020), 336 teacher educators have highly rated their competency levels in relation to the Teacher Educator Technology Competencies (TETCs).

In conclusion, teacher educators are perceived as role models by future teachers. Both pre-service and in-service teachers agreed that their education teachers were their best models of TPACK. Thus, the more teacher educators are competent in technology integration, the more their future teachers will be skilled in that.

5.2 Impediments to Technology Integration

The second research question in this study is: What are the barriers/impediments you face/may face when you want to integrate technology into teaching? This question was directed to pre-service teachers, in-service teachers, and teacher educators. As for administrators, they were asked: What are the barriers/impediments to promoting technology integration at the TEP? What do you do to deal with these impediments?

Many barriers to technology integration were mentioned by pre-service teachers, in-service teachers, teacher educators, and administrators. These impediments and sub-impediments fell into four main categories. The category that got the highest number of mentions from the participants was the impediments at the national level, followed by those at the institutional level, teacher level, and student level consecutively.

5.2.1 Impediments at the National Level

At the national level, the most common sub-impediment that was mentioned by the four participant groups was the weak infrastructure, which included a lack of or poor internet connection and electricity shortage whether at the educational institution or at teachers' and students' homes. Lebanon has been passing through a financial crisis since 2019, and the Lebanese pound has lost 98% of its value since then. This has made it difficult for the Lebanese government, which went bankrupt, to import fuel and provide its citizens with power, so people had to pay a lot of money to buy electricity from neighborhood generators. Moreover, the commercial banks in Lebanon have unlawfully restricted depositors' access to their own savings in US dollars. Thus, many Lebanese students and teachers weren't able to afford the high cost of power that they needed to charge their laptops and cell phones, run their PCs, and connect to the internet, which is already slow and faces cutoffs every now and then. All this has consequently led to limiting people's ability to use technology. For instance, one pre-

service teacher has mentioned that being in Lebanon isn't that easy and that it makes technology integration complicated due to internet connection problems and electricity cutoffs. Moreover, one in-service teacher has mentioned that the most difficult barrier is the lack of internet and electricity, whether at school or with students. As for teacher educators, one has mentioned that the bad internet connection and the electricity cutoffs in Lebanon do prevent many students and teachers from using technology. This problem was more prevalent during the pandemic, when all the teaching processes shifted online.

In the literature, several studies have also indicated that poor or limited internet connection was a major impediment to integrating technology in the teaching-learning process (Alrwaished et al., 2017; Cam & Koc, 2021; Durak, 2021; Isler & Yildirim, 2018; Nasri et al., 2020). However, other studies have discovered situations in which these issues weren't the main problems. This might be especially true in circumstances with ample resources or places with reliable infrastructure, where other considerations come first. For instance, in one study that was conducted in the United States, the lack of training and technical support, the lack of administrator priorities and support, the lack of resource allocation and convenience, and the inability to reduce teacher workload were the main barriers identified for technology integration (Hartley, 2014). Another study conducted in the United States and other countries found that the main impediments to technology integration are resources, the institution, subject culture, attitudes and beliefs, knowledge and skills, and assessment (Hew & Brush, 2007). Internet and electricity were not mentioned within the identified barriers.

5.2.2 Impediments at the Institutional Level

At the institutional level, the most common sub-impediment was the lack of or limited resources, followed by the curriculum and the lack of technical support, and finally the lack of adequate professional training.

To start with, the four participant groups have agreed that the lack of or limited technological resources (laptops, PCs, LCDs, interactive whiteboards, computer labs, and software applications) at the educational institution is a major impediment to integrating technology. This result is consistent with previous studies (Cam & Koc, 2021; Isler & Yildirim, 2018; Tiba & Condy, 2021; Tunjera & Chigona, 2020; Zipke et al., 2019). During the interview, some teacher educators and administrators reported that because classes are not equipped with laptops and projectors, teachers have to get theirs or borrow them from the administration and then return them after the session is over. Teacher educators have to follow this process even for the simplest form of technology integration, which is displaying a PowerPoint presentation. This not only demotivates and frustrates teacher educators but also wastes their class time. Participants have also mentioned not having access to subject-specific applications or website subscriptions compared to general technologies as an impediment to promoting technology integration, and this goes in accordance with other studies (Valtonen et al., 2019). Without the presence of technological resources at universities, teacher educators won't be able to integrate technology and model it for pre-service teachers. Moreover, as several pre-service teachers have reported in the interview, technological resources are also

limited in many schools where they do their field placement, thus depriving them of an authentic experience with technology integration. In one of the studies that support this finding (Oakley, 2020), pre-service teachers found difficulty carrying out an educational task due to inadequate school equipment. During the interview, one pre-service teacher said that he himself bought an LCD projector and subscribed to Prezi to deliver his lessons at school. This problem was also reported by in-service teachers, who said that they could not secure a computer in their classes.

Next, preservice teachers, in-service teachers, and teacher educators have also mentioned curriculum as another impediment to technology integration. The set curriculum can be a real barrier for teachers to employ technology in their classes (Zhao et al., 2002). Participants have commented that the main problem with the curriculum is that it is overloaded, and this is troublesome because it frequently means that teachers have little time to dive deeply into subjects, foster critical thinking, or employ a variety of teaching techniques. Instead, teachers may feel under pressure to cover all the material, frequently at the price of fulfilling learning opportunities and leaving some space for innovation and technology integration. This was clear in the interview response of one teacher educator who said that they don't teach for mastery but to finish the curriculum. That was supported in the literature by Voogt and McKenney (2017) who mentioned that some curricula in some countries have limited room for technology integration, and this is because students need to be well-prepared for the national assessments. As a result, teachers' concentration is directed toward covering the whole content rather than integrating technology into the curriculum. Moreover, one pre-service teacher has mentioned that, at schools, the session duration is around 40 minutes, during which they have to set up the laptop and projector, which consumes some of the class time. They also have to follow the time required for every lesson as indicated on the curriculum, and this may make them avoid using technology in order not to lose time and be able to finish the lesson within the time required by the school. This problem was also addressed by Becker (2000) in his study, which included over 4,000 teachers from more than 1,100 U.S. schools. The study concluded that the majority of high school students are allotted less than an hour in a single class session to complete their tasks. This restricted timeframe limits the range of teaching methods that educators can employ. As a result, a smaller number of teachers regularly incorporate computer-based activities into their lesson plans.

Third, participants have also perceived the lack of technical support as an impediment, and this is consistent with several previous studies in the literature (Ertmer, 1999; Hew & Brush, 2007; Lai et al., 2002; Rogers, 2000; Tunjera & Chigona, 2020; Wachira & Keengwe, 2011). One administrator has mentioned that due to budget constraints at the university, there is a lack of technical support. On-site and ongoing support must be provided to teacher educators at universities and to school teachers, as the availability of technical support significantly influences teachers' perceived ease of technology usage (Inan & Lowther, 2010). A support person who can troubleshoot and fix hardware and software issues as they arise must be on site. It is challenging, if not impossible, to ignore 30 or more students and focus only on fixing a technology resource breakdown when a problem arises in class. When teacher educators at the TEP face any technical issue in their classes, they either try to fix it on their own or ask for

the help of their tech-savvy students. If things didn't work, they just ignore it and continue their lesson without using technology. The only classes that are equipped with phones that one can use to call the IT department are the computer labs that are dedicated to educational technology courses. The use of technology in education can be significantly impacted by the lack of technical support in different ways. First, it reduces teachers' confidence. If teachers believe they won't receive the required help when technical problems occur, they may be reluctant to use technology in their classrooms, and they might believe that technical obstacles are continually impeding their efforts to innovate. A problem during a session might throw the lesson off, waste valuable teaching time, and make the teacher less confident about using technology in the future. Second, it leads to decreased efficiency. When technical issues occur in the classroom and there is no technical support, teachers may end up devoting an excessive amount of time on troubleshooting rather than on pedagogy, thus affecting their efficiency. Third, it increases the reliance on traditional teaching methods. Teachers may turn to traditional teaching techniques out of fear of technical problems or a lack of knowledge about how to handle them. Students are thus denied the potential advantages of technologically improved learning opportunities. Fourth, it limits collaborative opportunities. Collaborative technologies and platforms are frequently used in modern teaching, allowing for real-time collaboration between students and their teachers. Without adequate technological assistance, these technologies can go unused, depriving students of chances for collaborative learning. Finally, the absence of technical support affects students' experience. When students experience technological problems frequently, it may make them doubt the value and reliability of technology in the classroom. Moreover, their learning process could also be hampered by persistent technical issues.

Finally, one teacher educator has perceived the lack of adequate and ongoing professional development and training to be a barrier for technology integration, and this goes in line with other studies (Bauer & Kenton, 2005; Beggs, 2000; Ertmer, 1999; Prasojo et al., 2019). The lack of professional development can seriously impede the use of technology in education in a number of ways. First, it causes resistance to change. In the absence of adequate training and support, teachers may be less willing to adopt new technology due to their fear of the unknown or to their expectation that their workload would increase because of technology. Second, attempting to use new technologies without proper training might make teachers more anxious and frustrated, which could result in viewing technology integration in a negative way. Third, it causes a limited technological proficiency. Teachers may not be familiar with the newest technology platforms or tools without proper training, which would lower their level of competence and confidence when using technology in the classroom. Fourth, it leads to ineffective pedagogical usage. To illustrate, even if educators are proficient in the usage of a particular technology, they might not have the knowledge on how to successfully incorporate it into their teaching. Teachers may find it difficult to match technological resources with curriculum standards and learning objectives in the absence of professional development, leading to technology use that feels "tacked on" rather than naturally integrated. This proves the importance of professional development which frequently fills the gap between the mere usage of technological tools and the meaningful pedagogical integration. Finally, it may lead to reduced student engagement. Without standardized professional development, teachers may

implement technology in ineffective and inconsistent ways, causing unequal learning opportunities for students in different classes. Students may also lose interest and become distracted and disengaged, which would reduce the possible advantages of technology-enhanced learning. All administrators have mentioned that they provide workshops to the teacher educators at the TEP, and this explains why this impediment was mentioned by one participant only.

5.2.3 Impediments at the Teacher Level

At the teacher level, the most common sub-impediment was the lack of or limited technological knowledge and skills, followed by financial difficulties, lack of time, TPK difficulties, lack of will to learn or integrate technology, and age.

First, the four participant groups perceived the lack of or the limited technological knowledge and skills of teachers as an impediment, and this aligns with the results of other studies (Masoumi, 2021; Snoeyink & Ertmer, 2002; Tondeur et al., 2020; Voogt & McKenney, 2017; Williams et al., 2000). For instance, one pre-service teacher has mentioned that the main barrier to him is that he lacks some basic technology skills, like how to send or save a certain file. Also, one teacher educator has mentioned that the main barrier for him is when he misuses technology because he lacks some advanced skills. Administrators have also provided similar responses, as one of them mentioned that some instructors are not adequately proficient in using technology. However, when asked in the interview about their technology competency, the majority of pre-service teachers, in-service teachers, and teacher educators perceived themselves as competent or very competent using technology. Thus, a discrepancy exists between perceiving oneself as competent in using technology and simultaneously identifying a lack of technological skills as a barrier to integrating technology in education. This discrepancy can be explained from multiple angles. First, participants are making an external projection, so when talking about obstacles, they can be imposing their viewpoints on the larger community of educators. Even if they may feel individually proficient, based on conversations, training sessions, or observations, they may think that many of their colleagues aren't digitally skilled. Another explanation could be related to the scope of technology use. Although the majority of educators may feel comfortable using basic technology (like word processors, the internet, or simple presentation software), it's possible that they lack the specialized technology skills necessary for effective educational technology integration in the classroom.

Moreover, pre-service teachers, teacher educators, and administrators have identified the teachers' financial difficulties as one reason that would impede their ability to integrate technology. Some teachers might lack the financial ability to take advantage of the latest technologies at home and experiment with them, which would limit their exposure and familiarity. This point was raised by one administrator, who mentioned that when teacher educators want to develop their skills and learn new things, this will take them time and effort, and it will add a financial burden on them. Moreover, one teacher educator has reported that it was almost impossible for them in this economic situation to buy any new device to replace the broken one. However, if we take a look at the literature, we find out that studies have

discussed the governments' financial difficulties as an impediment to technology integration (Dotong et al., 2016) rather than the teachers' financial difficulties. One reason why teachers' financial difficulties have been mentioned in this study is because it was conducted during the hardest financial times in Lebanon, which have made it hard for teachers to be equipped with the basic personal technological tools.

The same participant groups have also identified time as another reason that may hinder them from integrating technology. This was also mentioned in previous studies (Butzin, 2001; Cuban et al., 2001; Hew & Brush, 2007; Karagiorgi, 2005; O'Mahony, 2003). Teachers frequently handle a variety of duties, including lesson planning, grading, and administrative work. It can be difficult to find the time to learn about new technology on top of their regular responsibilities. As one administrator has mentioned, instructors do not have enough time to plan for effective technology integration. Moreover, as some other participants have reported during the interview, preparing a technology-enhanced lesson is more time-consuming than traditional lessons, and this also corresponds with prior studies documented in the literature (Bauer & Kenton, 2005; Ertmer, 1999; Hew & Brush, 2007; Ottenbreit-Leftwich et al., 2010). Not only that, teachers nowadays are required to prepare paper and pencil resources in addition to technology-based ones, which consume their time. For this reason, when asked about their frequency of technology integration, one-quarter of in-service teachers said that they always do that, compared to more than half of teacher educators.

The four participant groups have also mentioned the lack of pedagogical knowledge in using technology as a barrier, and this mirrors other studies' results (Hew & Brush, 2007; Hughes, 2005; Koehler & Mishra, 2005; Wachira & Keengwe, 2011). The pedagogy of employing technology in the classroom can be unfamiliar to certain teachers. Hughes (2005) and Ertmer (1999) assert that teachers must possess a foundation of technology-supported pedagogy knowledge and skills from which they can rely on when attempting to incorporate technology into their instruction. The interview responses showed that some teachers had difficulties knowing when to use technology. Others struggled to make their students understand the lesson and manage their class time and students, all while integrating technology. One pre-service teacher has said that he is unfamiliar with using technology in the classroom, is unfamiliar with all the tools to integrate technology, is unable to get students to understand the lesson while using technology, does not have the ability to use technology without wasting class time, and is unable to manage the classroom while using technology. This hinders pre-service teachers' skills and ability to use technology as teachers. This was also supported by Lim et al. (2003) and Newhouse (2001), who mentioned that the lack of technology-related classroom management skills inhibits technology integration in the classroom. In-service teachers also face this problem. One of them mentioned that he is unable to know when and how to integrate technology and gave an example about teaching reading. He didn't know whether it was better to make students listen to the recorded text, to present the text on screen and make them read it, or to play a video. Moreover, one teacher educator has said that he lacks technology skills and knowledge, especially in pedagogy and classroom management. Being competent in technology doesn't necessitate that one is also good in the pedagogy of integrating technology, and this was reflected by one administrator when he said

that some instructors are not adequately proficient in using technology and that many of those who are proficient in technology use do not know how to use it to adequately transform the learning experience.

Two administrators have mentioned the lack of teachers' will to learn or to integrate technology as an impediment. One has said that some teacher educators are not technology-savvy and are not willing to learn. Another one has mentioned that sometimes teacher educators on their own are not willing to go the extra step to integrate technology, maybe because it is difficult for them, it's new, or it's time-consuming because they have to learn different things when they want to integrate technology. Some reasons for the lack of will could be due to teachers' resistance to change or to negative attitudes toward computers, which impede technology integration (Ertmer, 2005; Harris & Sullivan, 2000; Zhao et al., 2002). Some educators may think that technology adds little to the teaching and learning process and that traditional approaches are better. Others may have had negative encounters with using computers and technology, and for this, they are unwilling to learn about it. Other reasons could be due to anxiety, lack of interest, or lack of motivation (Duhaney, 2001), which may lead teachers to feel discouraged about spending time honing their technology skills because of this belief. One point to be mentioned here is that this barrier, the lack of will, is an intrinsic barrier that was identified by an external entity (administrators). None of the three teacher participants has perceived it as an impediment.

Finally, one pre-service teacher has mentioned teachers' age as an impediment. He said that some of the old teachers are unable to integrate technology into their classes effectively. According to studies, old teachers may be less proficient with computers and less confident integrating technology, which may limit their ability to experiment with new technologies in the classroom or change their regular teaching methods (Robinson, 2003; Snoeyink & Ertmer, 2002).

5.2.4 Impediments at the Student Level

At the student level, the most common sub-impediment was the lack of or limited technological knowledge and skills, followed by the lack of or limited resources and attitude towards technology.

Although most articles in the literature have mentioned teachers' lack of technological competency as a barrier to integrating technology, pre-service teachers, in-service teachers, and teacher educators in this study have addressed students' lack of technological knowledge and skills as an impediment to incorporating technology. They mentioned that many students, at school or at university, lack technology skills and are incompetent with using computers. They said that this is due to the Lebanese schools, which don't stress much on providing students with the necessary skills that qualify them to use technology. One teacher educator has mentioned that students are not experts in the technology needed for learning but are so when it comes to social media and gaming apps. As a result, teachers will feel demotivated to

integrate technology and will be hesitant to introduce advanced tools or applications since students are not familiar with the basic ones. Teachers will feel afraid that their students may struggle with technology and thus lose their focus on the content. Teachers may also feel afraid to waste class time trying to explain how to use a certain tool in order to be able to implement it in the learning process. As opposed to the results of this study, Ertmer et al. (2012) concluded in their study on teachers with award-winning technology practices that students' knowledge and skills are not found to be a barrier for technology integration. However, it is important to keep in mind that the participating teachers in the latter study are award-winning technology-using teachers; thus, they could have found ways to work around this barrier.

Second, students' lack of or limited access to technological resources was also mentioned by the four participant groups as an impediment, and this parallels what has been seen in earlier studies (Johnson et al., 2016; Norris et al., 2003). One teacher educator has raised the issue of students who come from low- and middle-income backgrounds and who are unable to have equal access to technology in order to experience learning. This barrier may limit teachers' choice of the assignment type. When students don't have access to technological resources, teachers would refrain from assigning online discussions and projects. Not only assignments will be limited, but also the feedback and the assessment types. Some digital tools can provide students with instant feedback that helps them quickly revise their strategies, and thus this process may be slowed as a result. Consistent access to hardware like laptops or tablets and software like internet browsers is a major need for effective integration (Johnson et al., 2016).

Lastly, students' attitude towards technology is also perceived as an impediment. Most research studies that mention attitude towards technology refer to teachers' attitudes rather than to students' attitudes. Participants in this study have complained about students' lack of seriousness and about their resistance to change and learn. As mentioned by one pre-service teacher, students don't take it seriously when it comes to teaching through technology. One in-service teacher has mentioned that students are convinced that technology is only used for entertaining purposes and not for education. Moreover, one teacher educator has said that students prefer the traditional way of teaching. Another one has mentioned that students are resistant to learning about new applications or trying to use something new, and he gave an example of his students who were assigned a task to be done on Padlet. They complained about it and asked if they could do it on a Word document instead because they didn't want to explore this new application.

According to Ertmer (1999), barriers to technology integration may be either first-order barriers or barriers that are extrinsic to teachers, like the weak infrastructure, the curriculum, and the lack of professional development, or second-order barriers or barriers that are intrinsic to teachers, like the lack of will to learn. The participants here have mentioned several barriers, most of which were first-order ones. Although teachers may not face all of these barriers together, the literature suggests that facing one impediment alone may impede effective technology integration (Hadley & Sheingold, 1993; Hannafin & Savenye, 1993). While many first-order barriers can be eliminated with the right tools, funding, and training, overcoming second-order barriers necessitates challenging one's ingrained routines and belief systems

(Ertmer, 1999). Consequently, policymakers, administrators, and educators should systematically analyze these barriers and strategize on potential solutions to improve the integration of technology in Lebanon's educational systems.

5.3 Recommendations for Technology Integration

The third research question in this study is: What are the recommendations to effectively integrate technology in teacher education programs?

To overcome the barriers discussed in the previous part, the four participant groups have provided some suggestions that have been classified into seven themes. The most common theme was to make some changes in the teaching and learning process, and then to provide professional development and training, to make some changes to the curriculum, to provide access to resources, to provide some motivation and support, to work on the innovation and creativity aspects, and finally to work on recruitment.

5.3.1 Teaching and Learning Process

The responses from participants provide a comprehensive insight into the perceived recommendations related to the teaching and learning process. In this regard, participants have stressed several points, like the role of teacher educators and cooperating teachers as pioneers of integration, the varied technology exposure, the focus on inclusive education, the imperative of hands-on practice, and feedback as a growth tool. First, cooperating teachers and teacher educators should act as role models and key individuals in establishing the tone for technology integration. Their behaviors, routines, and methods of instruction have a major effect on pre-service teachers' perceptions and subsequent practices. This was reflected by one in-service teacher who said that since instructors are role models to us, they should use technology while teaching because we learn from them. This aligns with previous studies in the literature (Durdu & Dag, 2017; Gill & Dalgarno, 2017; Isler & Yildirim, 2018; Redmond & Lock, 2019). Second, participants have expressed the need to be exposed to a variety of technological applications, as suggested in other studies (Kapici & Akcay, 2020; Karatas et al., 2017). Future teachers can obtain an in-depth understanding of the digital landscape by having each educator use a variety of technological tools. This variation equips them for classes in the real world, where adaptability is essential. Knowing one tool is not enough; they also need to be able to switch between a variety of tools depending on the educational situation. Witnessing varied tools and applications across different courses allows them to understand where the "technological" intersects with the "pedagogical" and "content" knowledge. Third, participants have mentioned that technologies that support special education needs are urgently needed. This emphasizes the value of inclusivity in contemporary classrooms and the ways in which technology may act as a bridge to successful inclusive education. To guarantee that future teachers are equipped to meet diverse learning needs, educators can make these tools a key component of the curriculum. Fourth, learning about technology is only half the battle; putting

it into practice is where true competence is built. This view is reflected in participants' responses, with many urging the use of technology-integrated assignments, projects, and in-class activities that force students to use and integrate technology. Such practical exposure guarantees that theoretical knowledge is supported by practical understanding. This suggestion was also mentioned in previous studies (Masoumi, 2021). Finally, pre-service teachers clearly want guidance and feedback on how to integrate technology into their lessons. They can hone their abilities and strategies by using feedback, which is viewed as a reflective tool, to make sure that they are integrating technology in the proper way. This was supported by the study of Cindric and Greguric (2019), who reported that pre-service teachers have benefited from the feedback they got on their technology-integrated project. This desire for feedback signifies the importance of reflective practice, a key component in honing one's pedagogical knowledge, especially when combined with technological tools. In the study conducted

5.3.2 Professional Development and Training

Participants' responses overwhelmingly underscore the pivotal role of professional development and training in bridging the technology integration gap, as it was the second highly rated recommendation for promoting technology integration in teaching. Pre-service teachers are aware of the effect teacher educators have on them when modeling technology integration in the classroom. As a result, they recommended providing teacher educators with "free workshops" on how to effectively integrate technology. Moreover, the emphasis placed by pre-service and in-service teachers on remaining "up to date" highlights the dynamic nature of technological knowledge. They are aware that a single training session is insufficient given the speed at which technology is developing and that learning must be constant and iterative. The difficulties presented by the sudden transition to online instruction during the epidemic, as mentioned by one in-service teacher, demonstrate how unpredictable the teaching environment is. This unpredictability emphasizes how crucial it is for instructors to embrace a lifelong learning perspective. Pre-service teachers' recommendations for ongoing training sessions guarantee that even after graduation, educators stay at the forefront of pedagogical and technological advancement. Administrators have also recommended that teacher educators and pre-service students be provided with professional development sessions related to technology. As for teacher educators, conducting professional development and training sessions was their highest recommended suggestion. They believe that teacher educators, especially those with low technology competency, need to update these skills by attending training sessions. Many other studies have also suggested providing professional development sessions for teacher educators (Cam & Koc, 2021; Tiba & Condy, 2021; Tondeur et al., 2020; Tunjera & Chigona, 2020; Voogt & McKenney, 2017). Conducting professional development sessions in technology use has a positive influence on teachers' use of technology (Blocher et al., 2011) and on their technology integration (Bhasin, 2012; Kopcha, 2012; Scott & Mouza, 2007). Moreover, these sessions must expose teachers to transformative technology-supported pedagogy and should not merely focus on how to operate technology (Hew & Brush, 2007). Participants have also recommended that the university gives them the opportunity to learn from peers who are good at technology integration, as this would boost their self-confidence in using technology. This idea was also supported by Voogt and McKenney (2017). Garet et

al. (2001) have called this process active learning, whereas Lim and Khine (2006) have called it buddy system strategy, and this is when teachers get the opportunity to observe expert ones integrating technology in action. Participants also proposed getting expert guest speakers who can introduce teacher educators and pre-service teachers to cutting-edge advancements and potential pedagogical applications. This approach ensures that educators are not only equipped with the tools but also with the strategies to integrate them effectively.

One point to address here is administrators' responses to the interview question about what they do to promote technology integration at the TEP. All administrators agreed that they do provide training and professional development to teacher educators. However, two of them have mentioned the lack of adequate professional development as a barrier, and this goes in line with several studies in the literature (Ertmer, 1999; Ertmer & Ottenbreit-Leftwich, 2013; Keengwe et al., 2008; Prasojo et al., 2019) that mentioned poor professional development as a barrier to technology integration. This could be explained in different ways. First, the provided trainings at the TEP follow the one-size-fits-all approach. Since not all teachers are equally adept at using technology, professional development workshops that don't differentiate based on the technology backgrounds and needs of the teachers may leave some teachers behind while making it too basic for others. Several studies (Dexter & Anderson, 2002; Keller et al., 2005) have stressed the importance of meeting teachers' needs for effective professional development and training. Second, the provided trainings may lack hands-on experience. In other words, they are highly theoretical and don't provide teachers with the chance to experience and experiment with technology. Teachers need practical experience to feel comfortable utilizing new technological tools. Third, there could be inadequate or insufficient follow-up support after the professional development sessions. Teachers will gradually face new difficulties and inquiries as a result of integrating technology into their classrooms, and thus they will be in frequent need of continual assistance. The fourth explanation could be the overemphasis on tools over pedagogy. Only emphasizing how to use technological tools without discussing how they might improve pedagogy and learning outcomes can make professional development disintegrated and less relevant to teachers. As explained in previous studies (Dexter & Anderson, 2002; Mulkeen, 2003), one effective feature of professional development is its ability to help teachers possess the essential technology-supported pedagogy knowledge and skill to effectively incorporate technology into their teaching methods. Another explanation could be that the provided trainings lack consistency. Teachers may have disconnected skills and knowledge as a result of infrequent or inconsistent professional development offerings that lack a clear and coherent long-term vision. Finally, the offered trainings may lack reflection and collaboration time. Successful professional development frequently gives teachers the chance to reflect on their own learning and work collaboratively with colleagues. Without this, the knowledge might not be adequately internalized or utilized. Another point to mention is that despite offering professional development for teacher educators, some of them do not attend them, and this was reported by one administrator who said that despite our reliance on technology, many instructors don't involve themselves in professional development.

5.3.3 Curriculum

Most recommendations about the curriculum were directed towards the TEP courses and syllabi. Participants have suggested reducing courses that are not directly related to education, thus leaving room for more educational technology courses that teach advanced educational technology skills and applications. These courses should not be theoretical and should instead provide pre-service teachers with the chance to practice the skills taught. This result agrees with a previous study (Masoumi, 2021) that mentioned that more digital technology courses should be introduced in the curriculum. Another suggestion concerning the educational technology course was to divide it into levels as per students' technology competency levels. So, students with good technological skills are to join the advanced level of the course, whereas those who know the basics can only join the beginner level of the course. Participants have also made suggestions concerning the practicum courses. They believe that this course should be designed in a way that focuses on teaching technology integration rather than teaching methods. In this regard, participants have also suggested allowing first-year students to take the practicum course, as it will introduce them to an authentic environment of technology integration and would make their expectations clearer. Another major recommendation was to integrate technology in all education courses, not limit it to educational technology courses, and have teacher educators use different tools so pre-service teachers are exposed to different tools and to different strategies of technology integration in different contexts. This will facilitate progressing their skills to their authentic classes when they graduate. Several studies have also supported infusing technology all through the TEP (Durdu & Dag, 2017; Masoumi, 2021; Tondeur et al., 2017). Finally, participants have suggested revisiting the TEP syllabi to leave room for technology integration (Cindric & Greguric, 2019). This includes reducing the number of lessons assigned or removing parts of specific lessons.

One point to note is that when asked about the barriers to integrating technology, participants have complained about the overloaded curriculum, which doesn't leave space for technology integration. None has complained about the courses at the TEP, their content, or how they are delivered. On the other hand, when asked about recommendations to promote technology integration, most answers were predominantly centered on the TEP courses, with few mentions of updating the TEP syllabi in order to leave some room for the use of technology. This could be explained by participants' perceived immediacy of curriculum overload. Teachers may perceive that the overloaded curriculum is a more urgent and concrete impediment that they encounter in their daily teaching. Thus, this urgent issue might take precedence over other possible issues, such the content and delivery of TEP courses. It may also be due to participants' expectations from TEP courses, such as that they should serve as the cornerstone for all future changes. Although they might not find any problems with the current course material or method of delivery, they could think that if changes are to be made, they need to start at the TEP course level. Finally, participants may have different contexts for responses. When describing barriers, teachers may be thinking about their own experiences in the classroom and the direct challenges they confront (such as a packed curriculum). When asked about ideas for the future, however, they are probably looking ahead, taking into account

areas where fundamental adjustments may have long-term effects, which is why TEP courses are emphasized.

5.3.4 Access to Resources

The four participant groups, especially teacher educators, have asked for some resources to be available on campus, like speedy Wi-Fi, laptops and LCD projectors in all classes, smartboards, language labs, access to licensed platforms, websites, and e-libraries. The availability of these resources, according to participants, will facilitate technology integration as teacher educators and pre-service teachers will have access to credible resources, and the latter will no longer have any excuse for not being able to do their assignments and projects. Although the weak infrastructure is a national problem, the university under study is now providing all campuses with electricity during class times. As at the individual level, it depends on the teachers' or students' financial ability and whether they can afford buying or acquiring power from different alternative resources like neighborhood generators or solar power system. This factor is essential for facilitating technology integration because it influences the technological knowledge component of TPACK. Several studies in the literature have also recommended providing proper technology-related equipment, internet access (Cam & Koc, 2021), and applications (Cetin-Dindar et al., 2018).

5.3.5 Motivation and Support

Participants have suggested providing motivation and support to promote technology integration in teaching. Future teachers need advice and encouragement from their teacher educators, and teacher educators need the support and encouragement of the administration to develop their technological skills and to always use technology. The motivation they get would help them have more self-confidence in their abilities and thus abandon traditional teaching and adopt technology integration in their classes. This transition from conventional to technology-integrated teaching techniques involves both a psychological and a technical journey. During this transformation, educators must be motivated, and they also need to feel supported. Finally, the administrators' suggestions touch on two important but frequently disregarded elements of technology integration: the need for institutional support and the impact of success stories. To effortlessly incorporate technology, there should be support from senior management. Using technology effectively requires teamwork. Resources, reforms in legislation, and most crucially, an innovation-friendly institutional culture are needed. This culture can be shaped through senior management's support, which can also supply the essential tools and frameworks for policymaking. Moreover, sharing success stories serves as a motivator. Administrators can provide a model to follow and inspiration to work toward similar results by presenting examples of how educators have successfully incorporated technology. It shows how the TPACK paradigm works in practice and how technology, pedagogy, and content work together in a seamless way. Several studies (Granger et al., 2002; Mouza, 2002) have suggested providing teachers with institution support and encouragement from the administrators, as this would also help in changing teachers' attitudes and beliefs.

5.3.6 Innovation and Creativity

In this regard, participants have suggested promoting technological innovation and creating expert teams. Launching contests for educational technology is a good way to promote technological knowledge (TK), which is a key element of the TPACK paradigm. Such competitions may accomplish two objectives. First, competitions' inherent reward systems can encourage teacher educators and students to learn more about technological tools and applications, which will improve their technical knowledge (TK). Second, it will encourage crowdsourcing ideas. By encouraging many participants to submit creative solutions, the university can gain access to a wealth of ideas, some of which may be ground-breaking and extremely helpful for integrating technology. As for expert teams, the TPACK framework's intersection of Technological and Pedagogical Knowledge (TPK) is represented by the advice to create a dedicated team of technology specialists within the department. These groups can provide training and ensure that technology is used successfully and efficiently and that teacher educators' technological and pedagogical competencies are strengthened. These expert teams also act as a drive to innovation by constantly looking for and incorporating cutting-edge technological solutions in the classroom to keep the curriculum up-to-date and relevant.

5.3.7 Recruitment

Four administrators and one teacher educator have provided some suggestions regarding recruiting some staff whose role is to empower different aspects of technology integration. They recommended establishing an IT department in each campus and recruiting IT personnel who can provide teacher educators and pre-service teachers with the needed help to integrate technology into their teaching. They believe that the IT personnel to be recruited should be qualified in this aspect, should have a unified vision, and should be sufficient in numbers compared to each campus' needs. Employing an inadequate number of technical support personnel would hinder teachers' integration of technology, as they would feel overwhelmed by teacher requests, and would not respond swiftly or adequately (Cuban et al., 2001). Another suggestion in this regard that was also supported by Tunjera and Chigona (2020) was to recruit technology-proficient teacher educators who can efficiently integrate technology in their own classes and who can, as well, act as peer tutors and help their colleagues at the TEP integrate technology into their teaching. These technology-adept teacher educators should be granted release time and some incentives since they will be devoting much of their time and effort in this process. So, according to the participants, recruitment should include not only IT personnel but also teacher educators. The recruitment process should also follow some standards concerning quantity and quality. If properly applied, this suggestion can have a substantial effect on the TPACK of the faculty as a whole, thereby fostering technology integration. It can also help in overcoming several barriers, like the lack of technical support, teachers' lack of technical knowledge and skills, and TPK difficulties. Moreover, it can indirectly help in dealing with students' lack of technical knowledge and skills, and this happens because teacher educators act as role models to their students. So, whenever they are effectively integrating technology, this will reflect on their students' skills.

In conclusion, the responses from the four participant groups revealed a consensus on a number of important strategies to promote technology integration. All of these strategies are vital for educators to establish a robust TPACK. However, each group had distinct perspectives that highlighted various aspects of the TPACK model, highlighting the complexity and multifaceted nature of technology integration in education.

5.4 Best Practices for Technology Integration

The fourth research question in this study is: What are the best practices for integrating technology into teacher education programs?

By examining teacher educators' best practices for technology integration as perceived by pre-service teachers and in-service teachers and as expressed by teacher educators themselves, we can gain insights into how the Teacher Education Program (TEP) aligns with the TPACK framework.

Participants have mentioned a vast array of tools used across the different aspects of the teaching-learning process. These tools have versatile functionalities and can be used in multiple ways depending on the teaching context and objective. To start with, some of the mentioned tools were used for content delivery and presentation, like Microsoft PowerPoint, Google Slides, Prezi, Pear Deck, Nearpod, Google Sites, and YouTube. There were also tools that were used for brainstorming and ideation, like MindMup. In one study (Cam & Koc, 2021), Prezi, a mind-mapping application, and others were used to deliver a technology-based lesson. The results show that this lesson had a positive effect on pre-service teachers' attitudes and that it attracted their attention and made them more actively engaged in the lesson.

Other programs were used for explanation and demonstration, like Screencast-O-Matic and StoryboardThat. In their study, Asik et al. (2018) have used a storytelling application in addition to several other applications to help pre-service teachers learn technology by design approach. The results of this study show that the approach used has led to deeper learning and increased motivation on the pre-service teachers' side. The approach has also promoted pre-service teachers' TPACK, especially their TK, TCK, and TPK. In another study (Oakley, 2020), pre-service teachers were asked to create digital storybooks. The technology used has developed pre-service teachers' TPACK in teaching literacy for the early years. Moreover, pre-service teachers have found this technology engaging.

Whiteboard, Padlet, Jamboard, and Mentimeter were used for engagement and interaction. Participants have also mentioned a variety of tools used for assessment and feedback, like Kahoot, Socrative, Quizizz, Quizlet, and Google Forms. In one study (Durak, 2021), participants were introduced to different technologies, including Prezi, Edmodo, Padlet, Kahoot, Socrative, storyboardThat, and others, and they were assigned different tasks. These tasks have resulted in an increase in technology use attitudes, higher levels of motivation and satisfaction, and higher technology integration self-efficacy.

Participants have also mentioned some tools like, Google Classroom, Microsoft Teams, and Edmodo for online learning and course management. Other tools include Google Calendar for time management, Zoom and Google Meet for communication, and Englishwsheets.com for resource creation.

This enormous number of tools highlighted by the participants underlines the importance placed on technological knowledge. The frequent use of these technological tools demonstrates the TEP's dedication to providing future teachers with a comprehensive toolkit that is in line with the TK domain of TPACK. This increased emphasis on TK could be due to the current growth in online learning, especially in light of global events such as the COVID-19 epidemic. This shift has necessitated the use of digital tools to enable and facilitate remote learning. Furthermore, technology resources are typically the most practical and available option for teachers looking to innovate in their classrooms, which leads to more frequent discussion and investigation of these resources.

As for TPK, it was manifested in pre-service teachers' emphasis on particular educational practices, such as using StoryboardThat for storytelling, Edpuzzle to keep students engaged during video classes, and Kahoot to encourage shy students to participate in a whole-class activity since it allows having anonymous user names. Teacher educators have also discussed some practices that reflect an integration of pedagogical and technological knowledge. For instance, they have talked about using technology to facilitate project-based learning, target different learning styles, differentiate instruction, and engage students. This reflects that teacher educators are not just delivering content; they're doing so in pedagogically sound ways, ensuring content comprehension and retention. As for TCK practices, they were reflected in the response of one in-service teacher when he mentioned using englishwsheets.com to prepare worksheets for English language classes.

It is worth mentioning that the integration of technology with content (TCK) or with pedagogy and content (TPACK) wasn't much stressed by the participants, and this could be due to the fact that the responses provided by pre-service and in-service teachers were about education courses in general. Moreover, when teacher educators were responding to this question, they were implicitly talking about the subject matter they teach. Taking this into consideration, we can say that the heart of TPACK's intersection is mostly captured by the all-encompassing approach of many teacher educators, which ranges from using platforms like Edpuzzle for enriched content delivery to using Google Forms to assess prerequisite skills. Many teacher educators are not just using technology or employing successful pedagogical techniques; they're doing it in a way that seamlessly combines content, pedagogy, and technology. However, this integration is perceived as an integration of technology and content only from the pre-service teachers' perspective. Pre-service teachers are witnessing how their teacher educators are using technology to teach a certain subject, but what is implicit to them is the pedagogy of using these specific tools. To illustrate, pre-service teachers are not explicitly introduced to why their teacher educators have chosen a specific tool to do a specific activity at a specific time. They are not aware of the why, what, and when of using these technologies. When pre-service teachers are trained to answer these questions, we can then say

that the TEP's technology integration practices are clearly aligned with the TPACK framework and that the program does more than simply introducing educators to new tools.

5.5 TEP's Preparation for Technology Integration

The fifth research question in this study is: Do TEPs at this Lebanese university prepare pre-service teachers to integrate technology into their future teaching?

To answer the question, the perspectives of pre-service teachers and in-service teachers will be considered.

First, more than 75% of pre-service teachers have explicitly expressed that the TEP is preparing them to integrate technology and that they are ready to do so in their future teaching. This feedback could be supported by their positive TPACK perception as reflected in the questionnaire and their positive perception of their technology competency as expressed in the interview. It could also be supported by their reflection on their teacher educators' technology integration performance, as the majority have perceived more than half of their Education teacher educators as good models of technology integration. Moreover, pre-service teachers have listed several useful technology integration practices that they have witnessed from their teacher educators and that they will implement in their future teaching. What supports pre-service teachers' positive reflection on their teacher educators' technology competency is the latter's interview responses. Teacher educators have mentioned that they perceive themselves as having good technology competency. Moreover, the majority of them integrate technology very frequently in almost all aspects of the teaching-learning process.

When comparing pre-service teachers' readiness to integrate technology, we find that those at the graduate level are more ready, and this may be due to the chances and opportunities they had to integrate technology themselves since most of them are currently teaching at schools, unlike undergraduate ones who lack exposure and training.

So, most pre-service teachers believe that the TEP has prepared them to integrate technology in their future teaching. However, if we compare these responses to pre-service teachers' responses concerning their readiness to integrate technology into their future teaching, we find some discrepancies. Pre-service teachers who mentioned that the TEP hasn't prepared them to integrate technology but were ready to integrate technology have referred that to self-development and justified it by saying that they have attended several workshops and webinars about technology integration. They also mentioned that the TEP has provided them with strategies and theories, but when it comes to application, they were only able to do so when they started teaching at schools. This explains why pre-service teachers at the graduate level have reflected a higher competency level (very competent) using technology compared to those at the undergraduate level. On the other hand, those who mentioned that the TEP has prepared them to integrate technology but are not ready to do so themselves have justified that

by saying that they need to practice using and integrating technology and that they need more time to get familiar with that.

In the pre-service teachers' questionnaire, the item "I can learn technology easily" got the highest number of strongly agree responses, whereas the item "I can choose technologies that enhance the teaching approaches for a lesson" got the highest number of strongly disagree responses. This data shows that pre-service teachers' main difficulty with technology integration is not their ability to learn it or use it, but their ability to make the right choice as to the best tools to use in their teaching. Pre-service teachers are exposed to different educational tools in the TEP, whether by being taught about them directly in the educational technology courses or by observing teacher educators using them in class. However, the missing link is that they are only taught how to use these tools. No explicit practices are done in teaching them the pedagogy for using these tools.

As for in-service teachers, half of them believe that the TEP has prepared them to integrate technology into their teaching. This percentage is lower than that of pre-service teachers', and this could be attributed to several reasons. First, that could be due to the effect of COVID-19 on education. To illustrate, the global pandemic has caused a sudden transition from conventional classroom instruction to online learning. Being in the training phase during or close to this time, pre-service teachers may have received more specialized training on online teaching tools and methods as an immediate response to the challenges presented by the pandemic. The in-service teachers, on the other hand, might have felt unprepared for such a sudden change, leading them to believe that their TEP did not effectively prepare them for this unusual change. Given the urgency of the situation, it's possible that the sudden reliance on online resources like Google Classroom, Zoom, and other platforms would have been better integrated into pre-service teachers' training. The second reason could be the recruitment of new teacher educators with good technology competency. The university has recently hired teacher educators who are more skilled with modern technological tools or have specific abilities in technology integration after realizing the growing significance of technology in education. These new teacher educators would be more inclined to stress and use technological tools and approaches in their teaching methodology. The beneficiaries of this enhanced emphasis would be pre-service teachers who are currently completing their training. In contrast, in-service teachers may have received instruction from teacher educators who adhered to more traditional teaching philosophies and who did not place as much emphasis on technological integration. Several in-service teachers have mentioned that their teacher educators' use of technology at the TEP was limited to Microsoft Office. Third, this difference in perception of TEP preparation could be due to expectations and real-world challenges. After dealing with real-life classroom situations, in-service teachers may have encountered difficulties that weren't covered in their training, which made them feel underprepared. The last reason could be due to the rapid technical advancements. Even the most advanced tools and platforms today could become outdated in a few years. If they have been working in the field for some time, in-service teachers may be evaluating their level of preparedness in relation to current technological requirements rather than those that were in place when they were in their TEP.

In the questionnaire, in-service teachers have reflected a positive TPACK perception, and they have also reflected a positive perception of their technology competency during the interview. Moreover, almost two-thirds of them do always or almost always integrate technology into their current teaching in all aspects of the teaching-learning process. Also, around 75% believe that more than half of their teacher educators at the TEP were good models of technology integration. So, in-service teachers didn't have a problem with teacher educators as role models; their problem was with the active engagement in technology integration. Even if teacher educators may have served as outstanding examples of how to use technology, this does not mean that in-service teachers will automatically feel ready to use it. Observing someone use technology skillfully is one thing, but having the practical knowledge and self-assurance to use it in one's own classroom is quite another. This inference could be supported by in-service teachers' interview responses, where they have mentioned that they didn't get enough practical training on the tools learned.

In conclusion, the majority of the participants believe that the TEP has prepared them to integrate technology into teaching. However, when we analyze the participants' responses to the questions about the impediments and the recommendations, we can then say that the participants' belief that the TEP has prepared them to integrate technology was based on what they have observed and not what they can authentically practice. Teacher educators are being good role models, but this is not enough. Future teachers need to be explicitly trained on the pedagogical aspect of using technology, and they should be provided with ample opportunities to practice that in authentic settings.

Chapter 6: Conclusion

This chapter concludes the study. It summarizes the study objectives, methodology, and findings and provides the research contributions, implications and recommendations, limitations, and suggestions for future studies.

6.1 Recapitulation of Research Objectives

One of the most important and continuous challenges that educational institutions throughout the world confront is the integration of technology into teacher education programs. This study looked at many facets of integrating technology at the Teacher Education Program (TEP) at nine campuses of a private university in Lebanon. First, it sought to study the alignment of the TEPs at this Lebanese university with the TPACK framework and thus assess their readiness to prepare future teachers to integrate technology into their teaching. Second, it aimed at assessing the self-perception of TPACK among pre-service teachers and in-service teachers who have previously graduated from the same university under study. Finally, this study tried to identify the barriers that impede technology integration, provide some recommendations to promote this integration, and uncover the best practices for this integration.

6.2 Recapitulation of Research Methodology

This study has adopted the mixed-method triangulation approach. The quantitative data were collected using the adapted version of the TPACK questionnaire developed by Schmidt et al. (2009) and was electronically distributed to 187 pre-service teachers and 57 in-service teachers. This questionnaire studies the participants' self-perception of every TPACK construct. It also studies the participants' perceptions of their TPACK models, and that include teacher education professors, professors outside of teacher education, and cooperating teachers. As for the qualitative data, it was collected through interviews and document analysis of the syllabi. The semi-structured interviews were conducted with 57 pre-service teachers, 20 in-service teachers, 21 teacher educators, and 6 administrators. The questions posed were mainly about the participants' technology competency, the perceived barriers, improvements, and best practices for technology integration, and whether the TEP is preparing future teachers to integrate technology into their teaching. As for the document analysis, 28 undergraduate and 17 graduate course syllabi were studied. All course outcomes were analyzed and categorized under their relevant TPACK construct, and then the total mentions of every construct were calculated and compared.

6.3 Summary of Key Findings

This study has answered five research questions, the first of which was about the participants' perception of their own TPACK level. Pre-service teachers as well as in-service teachers have perceived themselves as skilled and knowledgeable across the seven TPACK constructs, and they have also perceived themselves as competent or highly competent using technology in the interview. Pre-service teachers' most positive perception was towards CK, PK, and PCK. This positive perception decreases slightly for technology constructs (TPK,

TCK, TPACK, and TK). This could be first explained by the TEP's curriculum, which according to the syllabi analysis, emphasizes CK, PK, and PCK. Second, as reported during the interview, pre-service teachers are not getting ample opportunities and hands-on experience to practice technology themselves, whether during their education courses or during their practicum at schools. Moreover, pre-service teachers are not fully exposed to technology integration across all their education courses, non-education courses, and practicum experience, and this was reflected in the second part of the questionnaire and in the administrators' interview response when they mentioned that there are currently no rules imposed on teacher educators to integrate technology in their teaching. It seems that pre-service teachers' perceived technology competency was affected by several factors. First, the shift to online teaching because of the pandemic has forced all teacher educators, pre-service teachers, and in-service teachers to use technology, as it was the only means for them to communicate, prepare and deliver content, assess, provide feedback, and learn. This has boosted their confidence regarding their ability to use a variety of educational technology tools. Second, it seems that pre-service teachers' academic development is not their only source of confidence. It is not what they are being taught, but how they are being taught by their teacher educators, and this explains pre-service teachers' perceptions towards most of their education educators as models of TPACK, where at the same time the results of the syllabi analysis show that the concentration on technology constructs was almost missing. As for in-service teachers, their highest positive perceptions were towards PK and PCK, and this could be due to their practical classroom experience, ongoing professional development, reflection and iteration, peer interaction and collaboration, and direct feedback from students and coordinators. These two constructs were also higher than any technology construct, and this could be referred, as reported in the interview responses, to the lack of or weak internet connection, lack of or limited technological resources, limited access to technical support at schools, limited time and condensed curriculum, and their feeling of being overwhelmed using technology. In addition, in-service teachers' CK perception was lower than many other constructs, and this may be due to the ongoing professional development that they receive, which focuses mainly on pedagogy and technology, their comfortable level of teaching a certain subject for years and thus not feeling the need to deepen their CK, the dynamic nature of the subject matter taught, the curriculum constraints and the use of comprehensive curricular material, and teaching lower grade levels and several subject matters. Moreover, in-service teachers showed an overall higher perceived TPACK across the seven constructs compared to pre-service teachers. The highest difference was for TK, PK, TCK, and PCK consecutively, whereas the lowest difference was for TPK, CK, and TPACK. Numerous factors could have played a role in that, including in-service teachers' experience and the application of information in the real world, feedback systems, exposure to a variety of classroom situations, flexibility, maturity, and confidence, as well as continued professional development. Thus, it's essential to approach this conclusion with caution. The difference in mean scores does not necessarily imply that pre-service teachers are deficient. They're at a different stage in their professional journey, and with the right support and experience, they too can reach or even surpass the competency levels of their in-service counterparts. As for teacher educators, most of them have reported that they are competent using technology and they have referred that to self-learning, experience and

workshops attended, and the shift to online learning due to Covid-19, which forced them to use technology.

As to the perceived impediments for technology integration, participants have listed many that were divided into four levels. First, there were the impediments at the national level that were the most common, and they included the lack of or weak infrastructure (electricity and internet). Second, there were impediments at the institutional level, and that includes the lack of or limited resources at the educational institution, the curriculum, the lack of technical support, and the lack of adequate professional development. Third, there were impediments at the teacher level, like the lack of or limited technological knowledge and skills, financial difficulties, lack of time and workload, TPK application difficulties, lack of will to learn or integrate technology, and the teachers' age. Finally, there were also some impediments at the student level, like the lack of or limited technological knowledge and skills, the lack of or limited resources, and the attitude towards technology.

Participants have also provided some recommendations to promote technology integration. The most common recommendations were related to the teaching and learning process. Participants have recommended that teacher educators and cooperating teachers play a vital role as models of TPACK integration. They have also recommended exposure to varied technology tools, a focus on inclusive education, the imperative of hands-on practice, and feedback as a growth tool. They have also made some recommendations related to conducting professional development sessions and trainings, providing chances to learn from peers who are good at technology integration, and getting expert speakers who can present cutting-edge educational technology advancements. A third suggestion was related to the curriculum, and it included some points related to reducing courses not related to education, dividing the educational technology course into levels, redesigning the practicum courses to stress teaching technology integration rather than teaching methods, allowing first-year students to take the practicum course, integrating technology across all courses and having teacher educators use different tools, and finally revisiting the syllabi to leave room for technology integration. Other recommendations were to provide access to resources, to provide motivation and support, to promote technological innovation, to create expert teams, and to recruit IT personnel and technology-proficient teacher educators who can act as peer tutors.

As for the best practices for integrating technology, participants have listed several applications that can be used in different aspects of the teaching and learning process. They have provided some applications for content delivery and presentation, explanation and demonstration, brainstorming and ideation, engagement and interaction, assessment and feedback, online learning and course management, time management, communication, and resource creation. Participants have also suggested using technology to facilitate project-based learning, target different learning styles, differentiate instruction, and engage students.

The majority of pre-service teachers believe that the TEP is preparing them to integrate technology and that they are ready to do so in their future teaching. The percentage of graduate pre-service teachers who feel ready to integrate technology is greater than that of undergraduate

pre-service teachers, and this could be attributed to the authentic chances they had at schools to integrate technology themselves. Moreover, some pre-service teachers who have mentioned that the TEP hasn't prepared them to integrate technology but feel ready to do so have justified that with self-development. On the other hand, some pre-service teachers have mentioned that the TEP is preparing them to integrate technology, but they don't feel ready to do so themselves, and they justified that by saying that they need more practice. As for in-service teachers, half of them only believe that the TEP has prepared them to integrate technology, and this percentage is lower than that of pre-service teachers. This could be due to several reasons, like the effect of COVID-19 on education, the recruitment of new teacher educators with good technology competency, and in-service teachers' expectations and real-world challenges.

6.4 Implications and Recommendations

The results of this study yield several implications and recommendations that are listed below. The list starts with those directly related to the TEP, like the well-defined rules, the curriculum, professional development, non-education and coordinating teachers, and innovation, and ends with those related to the university's senior administration's decisions, like infrastructure and recruitment.

First, based on the administrators' interview responses, one of the significant findings of this study is the absence of well-defined rules and regulations governing technology integration at the TEP. This may lead to inconsistency and uncertainty in incorporating technology into the teaching and learning process by educators and students. So, it is recommended to establish clear and comprehensive guidelines and regulations for incorporating technology at the TEP. These guidelines should outline expectations, responsibilities, and best practices and should adhere to international standards and frameworks pertaining to technology integration in education. There should also be a periodic review and update to these guidelines in order to stay up to date with the changes in educational methods and technological breakthroughs. Educators should also be provided with training and support to make sure they understand and comply with the set rules and regulations. By setting clear rules and regulations, the TEP can provide educators and students with a structured framework that directs their efforts toward technology integration and ensures consistency, accountability, and efficient use of technology in teacher education.

Second, the study shows that the current TEP curriculum is overloaded, which puts a burden on educators and impedes their ability to integrate technology into their teaching. As a result, a critical review of the current curricula should be conducted to identify the areas where non-essential content can be removed and redundant content eliminated. The revised curricula should ensure that the integration of technology is made a core component of all courses at the TEP. This should be reflected in the TEP syllabi course outcomes, which should stress TPACK construct. Technology should be integrated across all courses at the TEP, and pre-service teachers should be given several chances to integrate technology themselves. This could be done by designing technology-integrated assignments, projects, and in-class activities that

force pre-service teachers to use and integrate technology. Pre-service teachers should also be given appropriate feedback on their technology integration attempts. Moreover, the pedagogy of using technology should be discussed explicitly across all TEP courses. In other words, pedagogical and technological knowledge should be harmonized explicitly.

Third, it was found that professional development is an important factor for educators to improve their technological skills and knowledge. Overcoming obstacles to technology integration requires standardized and well-designed professional development programs. For this, it is recommended to conduct tailored and consistent professional development sessions that cater to the competency level and specific needs of individual educators. These trainings should discuss the pedagogy of using the technological tools and not just how to use them, and they should include hands-on experience in applying technology integration. After these training sessions, there should be adequate follow-up and support for educators, who should be given reflection and collaboration time to internalize the learned skills.

Fourth, the study highlights the need to include teacher educators of non-education courses and cooperating teachers in the pedagogical, content, technology integration process to yield better results. For this, interdisciplinary collaboration should be encouraged. Technology should be integrated across all courses at the TEP and by all teacher educators, so pre-service teachers are exposed to different models of technology integration pertaining to different subject matters. Moreover, the schools that pre-service teachers need to do their practicum at should be well-equipped technologically, and the cooperating teachers should be chosen based on their ability to model technology integration properly.

Fifth, the present study underscores the need to promote an innovative and supportive culture in teacher education programs. For this, the TEP should promote experimentation. Teacher educators should be encouraged to try out a variety of digital tools and teaching strategies in order to determine what works best for their specific educational contexts. The TEP should also recognize and reward innovation in technology integration and should provide incentives for teacher educators to adopt technology into their lessons by praising those who do so successfully. This will encourage others to follow suit. Finally, peer collaboration should be promoted, and teacher educators should be encouraged to work together and share their best practices for integrating technology.

Sixth, the results of this study highlight the importance of having reliable internet infrastructure and electricity and adequate technical resources such as hardware, software, and educational tools for a successful integration of technology. Inadequate access to any of these can limit the effectiveness of technology incorporation in the class. Consequently, educational institutions should invest and allocate resources in IT infrastructure in order to guarantee reliable and high-speed internet connection in classes. They should also put backup plans in place to guarantee uninterrupted access to online resources. A comprehensive assessment of the current available technological resources should be conducted to identify the gaps and study the areas of improvement. After that, the institution should allocate a budget to buy or maintain these resources. For instance, they can negotiate with software and hardware companies to

provide them with the needed educational tools and licenses at discounted prices. Providing the adequate resources necessary to meet educational needs enhances the learning experience and turns the role of technology from being a barrier to an asset in the educational process.

Finally, establishing a dedicated IT department and hiring more IT personnel can enhance the prompt technical support and infrastructure at the TEP. Thus, IT departments should be created at each campus, and qualified IT personnel with experience in educational technology and technical support should be hired. There should also be regular maintenance for the technology infrastructure to guarantee effective performance and investment to maintain and upgrade a good internet connection to support technology integration. Doing so can ensure that challenges related to technology are addressed promptly, which creates a conducive environment for the successful integration of technology. These recommendations that are related to IT personnel can help address the lack of TK that teacher educators are preoccupied with. However, what teacher educators really need is to develop their technology-related pedagogical knowledge and the intersection of the TK, PK, and CK. For this, another implication was the recruitment of teacher educators with solid technology and pedagogy integration skills who serve as role models and peer tutors and who can affect the quality of technology-related training in the TEP. For this reason, when hiring new teacher educators, priority should be given to candidates with demonstrated skills in technology integration. Recruiting technology-competent teacher educators contributes to the success of the TEP and provides it with a pool of peer tutors who can elevate the level of technology integration among teacher educators.

6.5 Contribution to Research

This study has made some contributions related to technology integration in education in the global context as well as the local context of Lebanon. It provides a foundation for the creation of a more technology-integrated and pedagogically sound learning environment. It has collected insights from pre-service teachers, in-service teachers, teacher educators, and administrators at one private university in Lebanon concerning their TPACK perception, their perceived impediments, recommendations, best practices, and their belief whether the TEP has prepared them to integrate technology, and this is considered an added value as little literature exists about the topic at hand in Lebanon.

The findings of this study can help policymakers make informed decisions and set standards and guidelines that would help improve the integration of technology in teacher education programs. Since the study identifies the strengths, weaknesses, and opportunities in current programs, it can help policymakers understand where improvements are needed. For example, based on the findings, they can allocate resources, such as funding for infrastructure and tools, and design more targeted and effective professional development programs, which can lead to a more skilled teaching workforce.

Moreover, course coordinators can make use of the results related to the barriers and improvements related to curriculum to redesign the course content and the syllabi in a way that enhances technology integration. For instance, they can leave some room in the curriculum to allow technology integration and adjust the content of the educational technology courses.

As for teacher educators, they can benefit from this study by incorporating the best practices into their teaching methods, explicitly teaching the pedagogical aspects of technology integration, and providing authentic opportunities for pre-service teachers to practice using technology.

6.6 Limitations of the Study

Every research study has some limitations that should be acknowledged to provide a balanced perspective on the findings. The limitations pertaining to this study are divided into three categories related to the study setting, participants, and tools used.

First, concerning the setting, this study was conducted at the TEP at one Lebanese private university, and this makes the study context-specific and restricts the generalizability of the findings to other educational institutions outside and inside Lebanon that might have different organizational structures, budgets, resources, and approaches for teacher preparation. For instance, many other private Lebanese universities target students that come from high-income families and thus ask for higher tuition fees. Such universities, for example, have better budgets and up-to-date resources and usually provide their teacher educators with trainings and professional development programs at an international level. On the contrary, the Lebanese public university, which is funded by the Lebanese government, lacks the minimum resources to integrate technology. All this may affect the readiness of the TEPs at these universities to prepare pre-service teachers to integrate technology into their future teaching. Moreover, this study was conducted during a critical time period. First, the data were collected during the peak period of the economic collapse that Lebanon has been passing through, when the major resources needed by any country to survive were almost missing. This may have caused participants to prioritize some barriers, like the weak infrastructure and made them overlook other impediments despite their major effect on technology integration. Second, the data were also collected after teacher educators, pre-service teachers, and in-service teachers became familiar with technology integration due to COVID-19 and the mandatory shift to online learning. This shift has forced participants, even those with weak technology skills, to get used to and implement technology in teaching, and this is why most of them have perceived themselves as competent in using technology.

Moreover, some limitations are related to participants, and this includes the sample size, missing participant groups, and gender distribution. The study's small sample size, especially for teacher educators and administrators, could have an impact on how representative the results are. The opinions and experiences of the participants might not fully represent the diversity of viewpoints in the area of teacher education. Another point is the absence of the

participation of teacher educators outside education as well as cooperating teachers. Teacher educators outside education may have provided insight on whether non-Education courses are or are not taking part in preparing future teachers to integrate technology. Moreover, cooperating teachers could have provided an objective opinion about the readiness and needs of pre-service teachers to integrate technology. Their opinion and feedback are valuable, as this is the only authentic teaching experience pre-service teachers are having at schools. In addition, most participants in all four groups were females. The scarcity of male voices might overlook gender-specific barriers and supports that could be crucial for understanding technology integration in education.

The last limitation pertains to the tools used in this study, which primarily depend on self-reported information and lack direct observation data. First, a significant part of the collected data is based on self-reported information, especially when it comes to the questionnaire and interviews. This may have given rise to problems such as social desirability bias, in which the participants may have reacted in ways they perceive to be expected or favorable, or in a way that would please the researchers or their instructors, potentially affecting the accuracy of their responses. Moreover, because the assessment of readiness and competence was based on participants' self-assessments, the responses' accuracy varies, and it's likely that some individuals have overestimated or underestimated their skills. Finally, the study lacks direct observation data on technology integration practices, which could have offered a more objective picture of the situation.

6.7 Future Studies

Even though this study has provided insightful information about the readiness of the TEP at one Lebanese private university to prepare future teachers to use technology in their teaching practices, there are still a number of areas that future research might explore. These potential research directions can further enhance our understanding of technology integration within teacher education programs.

First, as to context, comparative research analyses could be conducted across several TEPs at numerous Lebanese universities, targeting students from different socioeconomic backgrounds and programs with different visions and approaches. This can help identify the impediments and the best practices to integrate technology across a broader spectrum, thus analyzing the successful cases in order to come up with the best recommendations to enhance educational institutions' readiness to integrate technology and to prepare future teachers to do that as well. Moreover, future studies may consider investigating cross-cultural perspectives by studying TEPs across different cultural and regional settings, as this can provide valuable insight on how cultural considerations may affect educators' readiness to use technology in teaching.

As for time, longitudinal studies may be conducted that can track the technology integration skills of pre-service teachers starting from their first year at the TEP and into their

authentic teaching careers at schools. This can provide insights and comprehensive understanding of how technology integration competencies and readiness evolve and contribute to long-term preparation. Also, pre- and post- comparative studies can be carried out to investigate the effectiveness of certain intervention methods or professional development programs and thus identify areas of growth and potential gaps

Concerning the participants, teacher educators outside of education as well as cooperating teachers may be involved in future studies. Involving these two participant groups enhances the richness of the research, as it provides a holistic and comprehensive overview of technology integration preparedness from the viewpoint of the major role models in the journey of pre-service teachers to incorporate technology in their teaching. Moreover, future studies may consider gender-inclusive investigations. As has been mentioned previously, the majority of participants in this study were females. It is important for future studies to aim for a fairer representation of both genders so that the gender-specific features of technology integration preparedness can be thoroughly analyzed.

As for the tools used, an objective assessment of readiness and competence is needed. Future studies can include objective methods to assess participants' readiness and competency in technological integration, thereby addressing the drawbacks of depending solely on self-assessments. Performance-based evaluations, technological competence exams, or independent evaluators' observations of participants utilizing technology in authentic educational situations could all be part of this. A more accurate picture of participants' technical readiness can be obtained by comparing self-assessments with objective measurements.

Future studies may also investigate the integration of AI tools and methodologies in teacher education programs. These studies could focus on how AI can enhance the Technological, Pedagogical, and Content Knowledge (TPACK) of pre-service teachers, examining the effectiveness of various AI-based teaching tools and techniques in developing these competencies. Additionally, these studies could explore the challenges and opportunities of incorporating AI into teacher education, providing insights for developing more effective training programs that align with the TPACK framework.

Researchers can enhance teacher education programs and the integration of technology in K-12 classrooms by addressing these limitations and conducting additional research along these lines. This will lead to a more comprehensive understanding of technology readiness and competence among pre-service and in-service teachers.

6.8 Conclusion: A Vision for the Future

This study evaluates the readiness, competence, and preparation for technology integration among pre-service and in-service teachers in Lebanon, shedding light on the existing strengths, weaknesses, and opportunities within teacher education programs while providing valuable insights for enhancing technology integration in education.

In conclusion, the TEP at this university doesn't fully align with the TPACK framework, especially when it comes to the pedagogy of using technology and to the intersection of the three constructs, or the TPACK. It is suggested that the improvement of such alignment could be accomplished by overcoming the impediments to integrating technology identified in this study. For instance, it was found that at the TEP, there are no well-defined rules that govern technology integration; the curriculum is overloaded and doesn't leave room for technology integration; the integration of technology is not made a core component of the outcome of almost all courses at the TEP; some teachers lack pedagogical knowledge in using technology; and the resources for integration do not meet the needs. However, when we compare this to the perceptions of pre-service and in-service teachers, we find that they have a more positive view. It seems that their perception is based on what they are observing from their teacher educators and not what they are able to apply on the ground. Moreover, this positive perception seems to be based on how they are taught by their teacher educators and not what they are being taught. So, to confirm the results, class observation should be considered to overcome the drawbacks of self-reported data.

The research findings offer a basis for the TEP to develop a more inventive, pedagogically sound, and technologically integrated learning environment for pre-service and in-service teachers. By ensuring that upcoming educators are equipped to utilize technology in the classroom to its fullest, this objective raises the quality of instruction for the following generation of learners.

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Appendices

Appendix A

TPACK Survey (Adapted Version)

		Item
TK	1	I know how to solve my own technical problems.
	2	I can learn technology easily.
	3	I keep up with important new technologies.
	4	I frequently play around the technology.
	5	I know about a lot of different technologies.
	6	I have the technical skills I need to use technology.
CK	7	I have sufficient knowledge about my first teaching subject.
	8	I can use my first teaching subject (mathematical, historical, scientific, literary,..) as a way of thinking.
	9	I have various ways and strategies of developing my understanding of my first teaching subject.
PK	10	I know how to assess student performance in a classroom.
	11	I can adapt my teaching based-upon what students currently understand or do not understand
	12	I can adapt my teaching style to different learners.
	13	I can assess student learning in multiple ways.
	14	I can use a wide range of teaching approaches in a classroom setting.
	15	I am familiar with common student understandings and misconceptions.
	16	I know how to organize and maintain classroom management.
PCK	17	I can select effective teaching approaches to guide student thinking and learning in my first teaching subject.
TCK	18	I know about technologies that I can use for understanding and doing my first teaching subject.
TPK	19	I can choose technologies that enhance the teaching approaches for a lesson.
	20	I can choose technologies that enhance students' learning for a lesson
	21	My teacher education program has caused me to think more deeply about how technology could influence the teaching approaches I use in my classroom.
	22	I am thinking critically about how to use technology in my classroom.
	23	I can adapt the use of the technologies that I am learning about to different teaching activities.
	24	I can select technologies to use in my classroom that enhance what I teach, how I teach and what students learn
	25	I can use strategies that combine content, technologies and teaching approaches that I learned about in my coursework in my classroom.
	26	I can provide leadership in helping others to coordinate the use of content, technologies and teaching approaches at my school and/or district.
	27	I can choose technologies that enhance the content for a lesson.
TPACK	28	I can teach lessons that appropriately combine my first teaching subject, technologies and teaching approaches.

Models of TPACK (Faculty, PreK-12 teachers)	29	My education professors appropriately model combining content, technologies and teaching approaches in their teaching.
	30	My professors outside of education appropriately model combining content, technologies and teaching approaches in their teaching.
	31	My PreK-12 cooperating teachers (during practicum at schools) appropriately model combining content, technologies and teaching approaches in their teaching.

Models of TPACK	25% or less	26% - 50%	51% - 75%	76%- 100%
1. In general, approximately what percentage of your **teacher education professors** have provided an effective model of combining content, technologies and teaching approaches in their teaching?				
2. In general, approximately what percentage of your **professors outside of teacher education** have provided an effective modeled of combining content, technologies and teaching approaches in their teaching?				
3. In general, approximately what percentage of the **PreK-12 cooperating teachers** have provided an effective model of combining content, technologies and teaching approaches in their teaching?				

Appendix B

Interview Questions

Below are the interview questions for every participant group:

Pre-service teachers

1. How competent are you when it comes to using technology (not competent/competent/very competent)? List the tools/applications you are competent with.
2. What are the barriers/impediments you face/may face when you want to integrate technology in teaching?
3. What actions/improvements should be done at the Teacher Education Program to better prepare you to integrate technology in your future teaching?
4. What teacher educator practices have you witnessed from the instructors who taught you Education courses and that you found helpful to prepare you to integrate technology in your future teaching? List these practices.
5. To what degree is the Teacher Education Program preparing you to integrate technology in your future teaching? Do you find yourself ready to effectively implement technology in your future teaching?

In-service teachers

1. How competent are you when it comes to using technology (not competent/competent/very competent)? List the tools/applications you are competent with.
2. How often do you integrate technology in your teaching and in what aspects of the teaching process (explanation, assessment,…)?
3. What are the barriers/impediments you face when you want to integrate technology in teaching at your school?
4. What actions/improvements should be done at the Teacher Education Program to better prepare future teachers to integrate technology in their future teaching?
5. What teacher educator practices have you witnessed from the instructors who taught you Education courses and that you found helpful and decided to implement in your own teaching? List these practices.
6. To what degree did the Teacher Education Program prepare you to integrate technology in your teaching? Explain.

Teacher Educators

1. How competent are you when it comes to using technology (very competent, competent, not competent)? List the tools/applications you are competent with.
2. What is your perception of the role that technology plays in teaching?
3. How often do you integrate technology in your teaching and in what aspects of the teaching process (explanation, assessment,…)?

4. What are the barriers/impediments you face when you want to integrate technology in teaching?
5. What actions/improvements should be done at the Teacher Education Program to better prepare future teachers to integrate technology in their future teaching?
6. What are the best practices to integrate technology in teaching?

Administrators

1. To what degree is technology being integrated at the different levels and courses in the Teacher Education Program at your university?
2. Are there any rules/guidelines imposed on your teacher educators to integrate technology in their teaching? If yes, what are these rules/guidelines?
3. How do you support or promote technology integration at your Teacher Education Program? What equipment or services do you provide?
4. What are the barriers/impediments to promote technology integration at the Teacher Education Program? What do you do to deal with these impediments?
5. What actions/improvements should be done at the Teacher Education Program to better prepare future teachers to integrate technology in their future teaching?

Appendix C

Information Sheet for Participants

Title: The Alignment of Teacher Education Programs with the TPACK Framework and Their Readiness to Prepare Pre-Service Teachers to Integrate Technology in Their Future Teaching

Principal Investigator:
Jihan Khalifeh Mohamad - jihan.khalifehmohamad@estudiants.urv.cat - 009613454598

Unit and center: Doctoral Program of Humanistic Studies

Introduction

We are writing to inform you about a study in which you are invited to participate. It is our intention that you receive the correct and sufficient information so that you can evaluate and judge whether or not you want to participate in this study. Before deciding whether or not to participate, please read this document carefully, including information about this project. You can ask all the questions that arise and ask for any clarification on any aspect of it. We will clarify any doubts that may arise at any time. In addition, you can consult with the people you deem appropriate before deciding on your participation in the study.
The project has the favorable report of the Ethics Committee of the Rovira i Virgili University (CEIPSA-2022-TD-0001).
.
The study will be conducted at a Lebanese university called "Lebanese International University" or "LIU". There are no specific university or country regulations regarding ethics and data protection. However, I got the approval to conduct the study at LIU from the university President through the Dean of the School of Education. I sent the Dean an email having my study proposal and all the documents related to my study. He in turn sent it to the President and got his approval to conduct the study.

Voluntary participation

You should know that your participation is voluntary and that you may decide not to participate or change your decision and withdraw your consent at any time, since it does not alter the relationship with your teacher nor is it harmful in regards to your adacemic result.

General Description of the Study

The purpose of this study is, on the first stage, to study the alignment of teacher education programs (TEP) in Lebanon with the TPACK framework and their readiness to prepare pre-service teachers to integrate technology in their future teaching. It also examines the perceived TPACK of pre-service teachers at different levels of the teacher education program in the Lebanese educational context. On a subsequent stage, the study aims to explore the recommendations and the best practices to transform the techno-pedagogical competencies to pre-service teachers and the perceived impediments that may hinder this transformation.

This study will adopt a mixed method triangulation approach.
1- The quantitative data will be collected from pre-service teachers' (student teachers') survey. Student teachers will receive an email having a link to the questionnaire. The email will make it clear that student teachers have the right to accept or reject filling this questionnaire. Those who accept need to fill the questionnaire once and it will be conducted online via Google forms.

The questionnaire contains 34 questions that measure the perceptions of student teachers towards technological, pedagogical and content knowledge domains.
2- As for the qualitative data, it will be collected from interviews with university administrators, teacher educators and pre-service teachers, in addition to document analysis (syllabus).
As for the interviews, participants will receive an email inviting them to participate in an interview. The email will make it clear that participating in the interview is merely voluntary. Those who accept need to provide their phone numbers since the interview will be conducted over the phone.
As for the interviews, the interviewer will take notes and write down the interviewee replies. Interviewees will be identified as Participant1, Participant2, and so on. Thus, the data will be reported and stored without any identifying information to guarantee anonymity.
The interview questions will concentrate on participants' technology integration competency, tools and applications used in teaching, best practices, barriers and recommendations to integrate technology.
As for the number of participants, there will be around 100 participants (including administrators, teacher educators and pre-service teachers) for the interview and 250 for the questionnaire.

Where will we get that data from?
As for the email addresses, I will collect them from the School of Education at the university under study. The emails will be added in the BCC section so that no participant will have access to the email addresses.

As for the phone numbers, participants who accept to participate in the interview, will fill a form that asks them for:

1. Their phone number
2. A date to conduct the interview. They have to add a date that suits their schedule.
3. A time to conduct the interview. They have to add a time that suits their schedule.

What will we do with the data?
The collected personal data (email and phone) will be directly discarded after the questionnaire is filled out and the interview is conducted. The questionnaire data and the interview responses will be processed through SPSS and excel. The identity of the participants will remain anonymous. The results will not be identified by name or any other information that could be used to infer the identity of the participant.

Is the processed data the basic data required to conduct the investigation project?
The data collected from the questionnaire and the interview are the basic data for the study in addition to document analysis of the course syllabi.

Possible risks
The study does not pose any risk to the participants.
Participants' grades in any course will not be affected by their participation in the study through the TPACK questionnaire and the interview.

Expected benefits
Participation in the study will result in greater personal awareness or self-knowledge of one's capacity to integrate technology in teaching. Moreover, the knowledge obtained due to the study can help to advance the teaching practices in the School of Education.

Participants will not receive any financial benefit from their participation or the transfer of the pro-portioned data.

Confidentiality and Data Protection

All information collected about the participants in this study will be kept strictly confidential and with the application of the corresponding security measures that guarantee, in addition to their confidentiality, their integrity, availability, authenticity and traceability.

The main researcher's computer will be used to process the data, applying the information security measures established by Royal Decree 3/2010, which regulates the National Security Scheme. Specifically, the data will be collected through Google forms (for the questionnaire) and via the phone (for the interviews) and will be entered into the information system SPSS (for questionnaires) and the interview results will be coded and entered into excel sheets.

The main researcher of the study will comply with Organic Law 3/2018, of 5 December, on the protection of personal data and the guarantee of digital rights, in addition to Regulation (EU) no. 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of individuals with regard to the processing of personal data, and will sign a commitment to participation and confidentiality.

The purpose of the data processing is to participate in the study based on the consent of the participant. The participant may also consent to the re-use of data for future related studies.

The participant may interrupt his / her participation in the related study or future studies by withdrawing his / her consent at any time, without the need for justification. In this case, the data will not be deleted in order to guarantee the validity of the results and to comply with the legal obligations applicable to the study, but they will be coded in such a way that it is not possible to link them to your person.

Extended Information on the Processing of Personal Data

In accordance with the provisions of current legislation on data protection applicable to the Universitat Rovira i Virgili (URV) and published in the section "Applicable legislation" of the space "Protection of personal data" of the Electronic Office (https://seuelectronica.urv.cat/rgpd/), the following information is made known to interested parties:

a) Who is responsible for the processing of your data?

Identification	Universitat Rovira i Virgili CIF: Q9350003A
Postal Address	Carrer de l'Escorxador, s/n 43003 Tarragona
Contact details of Data Protection Officers	Delegats de protecció de dades de la URV Correu electrònic: dpd@urv.cat

b) What personal data do we process and for what purpose?

Personal data is processed for the purpose of participating in the study of the doctoral thesis in the terms described in the information to participant sheet. In the event that the study provides for the publication, dissemination and reuse of the results obtained, including personal data, personal data will be used for this purpose as long as the interested party has given their consent.

c) To which recipients will your data be communicated?

In the context of the aforementioned processing, your data will not be transferred to third

parties unless there is a legal obligation or expressly stated in the information sheet to the participant.

d) What is the legitimacy for the processing of your data?
The legitimacy of this treatment is based on the express consent of the person concerned.

e) What security measures do we apply to the processing of your data?
The University is responsible for applying the security measures and other obligations deriving from the legislation on the protection of personal data in accordance with the National Security Scheme, Royal Decree 3/2010.
In this sense, Rovira i Virgili University has adopted a Security Policy which can be consulted in the section on "Legislation and regulations" on the University's website under "Own regulations" and "Other regulations". , http://www.urv.cat/ca/universitat/normatives/altres-normes/.
In addition, the Participant Information Sheet outlines some specific safety measures that will be considered during the study.

f) What are the rights of the interested parties?
The interested party has the right to access their personal data, to request the rectification of inaccurate data, to request the cancellation and deletion, and to object to the processing, including the elaboration of profiles, to limit up to at a certain date the processing of your data and the portability of the same, in electronic format.
The participant may interrupt their participation in the study by withdrawing their consent at any time, without explanation. In this case, the data may not be deleted in order to guarantee the validity of the results and to comply with the legal obligations applicable to the study, but it will not be possible to link them to your person.
You may exercise your rights of access, rectification, cancellation, opposition, limitation and portability by written communication, giving detailed reasons for the application, addressed to the General Registry (C / Escorxador, s / n, 43003 de Tarragona) or by submitting it to the General Registry of the University, in person or online, as indicated at https://seuelectronica.urv.cat/registre.html.
We also inform you that you have the right to file a complaint with the Catalan Data Protection Authority through the mechanism established. You can find more information at https://apdcat.gencat.cat/ca/inici.
Finally, we inform you that you can request information related to the protection of personal data by e-mail to our data protection delegates at the address of dpd@urv.cat.

g) How long will we keep your data?
The retention period of the data is 5 years after the end of the study, unless the participant information sheet sets a different period. In any case, the data will be kept until the consent of the interested party is revoked.

I have received this Fact Sheet.

Date: [DD / MM / YYYY]
Name and surname: [Name and surname]
Signature:

Appendix D

Informed Consent Form

Title of research project: The Alignment of Teacher Education Programs with the TPACK Framework and Their Readiness to Prepare Pre-Service Teachers to Integrate Technology in Their Future Teaching

Principal researcher's contact details:

Janaina Minelli de Oliveira Ramos
https://orcid.org/0000-0001-5946-3622
Rovira i Virgili University
Postal address: C / Nàpols, 154, 5-1. Barcelona, 08013.
Telephone: +34 666191691
Research group: MEDIS (2017-SGR 1674)

I .....[1]holder of identity card number.....

- I have read the copy that I have received of the participant information document regarding the study.
- I have been able to ask and have received answers to my personal questions regarding the study and my participation in it.
- I understand that I am participating in this study in accordance with the specifications in the participant information document and in accordance with the answers that I have received to my questions and I understand the risks and benefits that this entails.
- I accept that my participation is voluntary and I freely agree to participate in the study.
- I understand that I can withdraw at any time from participating in the study and that my withdrawal will not affect me negatively in any way.
- I have been informed about how my personal data will be processed.
- I give my consent for my data to be accessed and used under the conditions specified in the document containing information on the study addressed to the participant.

  ☐Yes ☐No

- [2]I give my consent for the dissemination of my personal data together with the publication of the results of the study.

  ☐Yes ☐No

- Once the research has been completed, the data obtained may be of interest to other related studies. In this regard, the following options are offered:

  ☐ **NOT TO AUTHORISE** the use of the data in other related research projects.

  ☐ **TO AUTHORISE** the use of the data in other related research projects.

[1] Indicate the full name of the participant.
[2] Only if the results of the study that are published give the name of the persons or any data that identify the person, or their image or voice without anonymization techniques.

[3] To express their consent, the participant signs the present consent form on..... in.....:

Signature of the participant .....

Doctoral Theses of the URV
Basic data protection information

Basic information on data protection (tabular format)

INFORMATION ON PERSONAL DATA PROTECTION	
Data Controller	The data controller is the Universitat Rovira i Virgili with Tax Identification Number Q9350003A and based at Carrer de l'Escorxador, s/n, 43003, Tarragona.
Purpose	To participate in the doctoral thesis[4] under the terms described in the participant information sheet. If the study intends to publish, disseminate and reuse the results obtained, including personal data, the personal data will be used for these purposes provided that the interested party has given their consent.
Rights	The individuals concerned can exercise their right to access, rectify, remove, move, limit or oppose the processing of their data in writing to the General Registry of the URV at the same address as the URV, or in person at the General Registry of the URV or telematically in accordance with the instructions at https://seuelectronica.urv.cat/registre.html.
Further information	Individuals can find additional information about the processing of personal data in the Doctoral thesis and about their rights at the URV's Processing Registry, which is published at https://seuelectronica.urv.cat/rgpd, where they will also find the Privacy Policy of the URV. They may also find this information on the Participant's Information Document regarding the study. Furthermore, they may ask our data protection officers any question regarding the protection of personal data by sending an email to dpd@urv.cat.

[3] If the participant can freely give their consent, use this section until the following note, the text of which can be eliminated.
[4] Indicate "research project" if it is a research project, "Doctoral Thesis" if it is a doctoral thesis or "Bachelor's or Master's Thesis" if it is a BT or MT.

Appendix E

Ethics Committee Favorable Report

CEIPSA
Comitè Ètic d'Investigació en Persones, Societat i Medi Ambient

ENGLISH

STATEMENT BY THE ETHICS COMMITTEE CONCERNING RESEARCH INTO PEOPLE, SOCIETY AND THE ENVIRONMENT

AITOR GÓMEZ GONZÁLEZ, President of the ETHICAL COMMITTEE CONCERNING RESEARCH INTO PEOPLE, SOCIETY AND THE ENVIRONMENT OF THE UNIVERSITAT ROVIRA I VIRGILI (CEIPSA) attests to the agreements passed.

During its meeting on 30/6/2022 (archive number 6/2022), the Committee evaluated and decided to issue a Favourable Report for the study entitled:

"The Alignment of Teacher Education Programs with the TPACK Framework and Their Readiness to Prepare Pre-Service Teachers to Integrate Technology in Their Future Teaching"

CEIPSA code: CEIPSA-2022-TD-0001
Doctoral Student: Jihan Khalifeh Mohamad
Doctoral Thesis Director: Janaina Minelli de Oliveira

THE COMMITTEE CONSIDERS THAT:

- The project proposal presented is in accordance with good scientific practices and the values of scientific correctness, training, justice, solidarity, protection of vulnerable subjects, dignified treatment, personal autonomy, privacy, confidentiality, reparation of damage and respect for human rights.
- The project proposal complies with current applicable European, Spanish, and Catalan legislation, as well as the URV's own regulations on R+D+I.
- The project proposal complies with the methodological, ethical, and legal requirements within the scope of CEIPSA's competences and in relation to its:

  a) Social value as a project.
  b) Research staff.
  c) Methodology.
  d) Specific ethical aspects, namely the risks and benefits, the measures regarding damage prevention and repair, the processes regarding selection and recruitment, the protection of vulnerable subjects, and the aspects relating to information, consent, privacy, and confidentiality.
  e) Compliance with the documentation, namely the informed consent document, the document confirming file security, the authorizations, and the current regulatory requirements.
- If relevant changes occur in the development of the research activity on the approved initial conditions, the researcher in charge must inform the committee of these changes before carrying them out, as specified in section 10.3.4 of the Rules of Procedure of this committee.
- As this research will be carried out in Lebanon, this committee recommends that the doctoral student reviews the legal aspects of the regulations of that country and asks to her to commit to working in accordance with the current code of good state scientific practices.

UNIVERSITAT ROVIRA i VIRGILI

CEIPSA

Comitè Ètic d'Investigació en Persones, Societat i Medi Ambient

If a member of this committee participates as a researcher / collaborator in a given project, they will not attend any meeting at which the project is discussed.

On the date of the URV's CEIPSA evaluation, the committee's members were:

President
Dr Aitor Gómez González
University Professor of the Department of Pedagogy of the URV

Secretary
Mrs. Cristina Salvadó Baza
CEIPSA Secretary

Members
Dr António Miguel Osório Da Costa
Associate Professor of the Department of Economics of the URV

Dr Gisela Cebrián Bernat
Lecturer at the URV's Department of Pedagogy

Dr Josefa Canals Sans
University Professor at the URV's Department of Psychology

Dr María Dolores Jiménez López
Associate Professor of the URV's Department of Romance Studies

Dr Maria Teresa Novo Molinero
Associate Professor of the URV's Department of Biochemistry and Biotechnology

Mr Antonio Cortés Martínez
URV Data Protection Officer

Ms Mireia Herranz Aparicio
URV Data Protection Officer

Ms Gemma Garcia Camps
Coordinator of the Joint Occupational Risk Prevention Office of the URV and the FURV

Ms Sandra Rodríguez Rodríguez
Lawyer from the URV's Legal Office

Signed by

AITOR GÓMEZ GONZÁLEZ - DNI 38140434v

Firmado digitalmente por AITOR GÓMEZ GONZÁLEZ - DNI 38140434v
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Dr Aitor Gómez González
President CEIPSA URV

Appendix F

Approval to Use TPACK Questionnaire

From: Crawford, Denise A [SOE] <dschmidt@iastate.edu>
Sent: Monday, January 3, 2022 7:23 PM
To: Jihan Khalifeh <jihankhalifeh@hotmail.com>
Subject: Re: Approval to use the questionnaire in my study

Dear Jihan,
Thank you for your interest in our TPACK survey. You have our permission to use the survey in your study. It looks good! Good luck!

Best,
Denise Crawford

Denise A. Schmidt-Crawford
Professor
Director, Center for Technology in Learning and Teaching
School of Education
Iowa State University
0624A Lagomarcino Hall
515.294.9141
dschmidt@iastate.edu
@SchmidtCrawford

President, Iowa Association of Colleges for Teacher Education (IACTE)
Past- President, Society for Information Technology and Teacher Education (SITE)
Apple Distinguished Educator (2003)

Appendix G

Sample Syllabi

EDIT250
Educational Technology for Teachers
Undergraduate

Course Description (وصف المادة):	▪ This course provides an overview of various technology methods and explores the utilization of technology as means to facilitate instruction to maximize learning outcomes. The purpose of the course is to broaden teachers' perspective of the important role technology plays in meeting the various needs of our diverse learners.
Course Objectives (اهداف المادة):	▪ Students will explore fundamental principles and theories related to the utilization of technology in education. ▪ Students will discover applications of the course material to improve their decision making in choosing the most effective and useful educational technology tool that would lead to maximizing the learning outcomes. ▪ Students will transfer theoretical knowledge to real life of the theories they learn through projects, case studies and presentations. ▪ Students will appreciate the importance of the underlying theories related to educational technology in decision-making processes in the field of education.
Course Outcomes (مخرجات المادة):	A student who successfully fulfills the course requirements will have demonstrated an ability to: 1. CO-1: Distinguish the several terminology related to educational technology. 2. CO-2: Identify effective technology tools and theories to improve teaching and learning 3. CO-3: Apply educational technology theories and tools effectively into the teaching and learning practices. 4. CO-4: Create their own e-portfolio
Covered Topics (محتوى المادة):	1. Educational technology and its evolution 2. Educational technology professional development 3. Emerging practices in the teaching learning process 4. 21st Century Skills 5. The TPACK Framework 6. Instructional Design /ASSURE Model 7. Web 2.0 Tools 8. Learning Management System 9. MOOCS 10. Mobile learning and applications 11. Google classroom 12. Google sites (E-Portfolio) 13. Google forms 14. Storyboard

	15. Word processing 16. Spreadsheet tools 17. Presentation tools 18. Creating online courses 19. Interactive whiteboard

Course Schedule

Week	Title	Notes
1.	• Course Syllabus • What is Educational Technology? • Evolution of Educational Technology • Educational Technology Professional Development • Emerging Practices in the Teaching-Learning Process (Lifelong Learning, Personalized Learning, Self-Learning)	➢ (PPT: Presentation 1)
2.	• Google Classroom ➢ Students should know how to use it as "students" and as "teachers". ➢ Create a classroom, add people, create assignments, grade and return assignments, share files, upload assignments,..)	➢ Students should practice Google classroom as a "student" and as a "teacher". Note: The instructor should create a Google classroom for his/her course to be used throughout the semester. Use it to upload the PowerPoint presentations and assignments and to grade them. Also use it to send students notifications and reminders. Students should use it to upload their assignments.
3.	• 21st Century Skills • The TPACK Framework • Instructional Design o Principles o Models • ASSURE Model	➢ (PPT: Presentation 2) ➢ Classwork group activity: Students should choose any grade level and any lesson in any subject matter and design a relevant activity that incorporates the 4C's.

4.	• Google sites	➢ After explaining Google sites, introduce the idea of e-portfolio. At this point, students should start working on their e-portfolio and should update it at the end of each lesson throughout the semester (until week 13). ➢ **Graded Assignment: E-portfolio** (To be graded at week 13)
5.	• Creating a Storyboard	➢ Use the online application: www.storyboardthat.com ➢ **Graded Assignment: Storyboard**
6.	• Word Processing: o Microsoft Word / Google Docs (formatting, layout, citation, styling)	
7.	• Spreadsheet Tools: o Microsoft Excel	➢ **Graded Assignment: Excel**
8.	• Spreadsheet Tools: o Google Sheets • Google Forms	 ➢ **Graded Assignment: Google Forms**
9.	• Google search tips (Using modifiers, file types, advanced Google image search,…) • Presentation Tools: o Presentation skills (Body language, eye contact, intonation, …) o Powerpoint tips (fonts used, font color and background color, use bullets, avoid long paragraphs, don't overuse animations, ….)	➢ Helpful website: https://www.pcmag.com/feature/326078/23-google-search-tips-you-ll-want-to-learn ➢ Classwork group activity: Students should create a short powerpoint presentation. They have to consider the Google search tips when looking for information/ pics/ video and the powerpoint tips they have been provided with when designing their presentation. Students should also practice presenting their powerpoints taking into consideration the presentation skills they have been provided with.

	• Presentation Tools: o Microsoft PowerPoint	
10.	• Presentation Tools: o Microsoft PowerPoint / Google Slides / Prezi / Slideshare	➢ Explain the term project (Case studies) to your students. - Students should submit it on Google classroom and as a hard copy (Microsoft Word). - Students should use powerpoint to present their project to their classmates. - The term project is due the last week in the semester. It can be done in groups.
11.	• Interactive whiteboard	➢ You can use the "smartboard notebook" software. **Graded Assignment: Smartboard Notebook**

12.	• Explore free educational software (Applications and platforms)
	  o Web 2.0 Tools
	  o Learning Management Systems (LMS)
	• MOOCs
	• Online learning (learning environments, gamification, etc.)
	• Mobile Learning
	• Mobile Applications
		➢ (PPT: Web 2.0 and LMS)

13.	• E-Portfolio presentations	➢ **Presentation** 80% of the grade should be dedicated to the e-portfolio content and design and 20% should be dedicated to the student's presentation skills.
14.	• Creating an online course	➢ You can use "Teachable" platform. https://teachable.com/
15.	**Term Project Presentations**	➢ **Presentation**

Assessment Methods & Grades Distribution

Assessment	Weight (%)
Participation	**20 %**
Assessment 1	**25 %**
Assessment 2	**25%**
Final Project	**30 %**

Textbook / References

1. Course notes and presentations
2. Clark, R. C., & Mayer, R. E. (2008). What is E-Learning? San Francisco: Pfeiffer.
3. Bellanca, J., Brandot, R. (2010). 21st Century Skills: Rethinking How Students Learn. Bloomington, IN: Solution Tree.
4. Beaty, L., & Allan , C. (2005). HEFCE strategy for e-learning. Bristol: Higher Education Funding Council for England.

EDUC346
Introduction to Classroom Management
Undergraduate

Course Description	This course examines the role of a teacher in creating a classroom environment conducive to learning. The aim of the course is to pinpoint the crucial role of the teacher in establishing a proactive classroom environment where students stay involved in tasks by abiding by the established rules and routines, and where disciplinary issues are well tackled by resorting to effective classroom management tools. It also assists teachers in maximizing students' attention and in reducing distractions.
Course Objectives	• Students will explore fundamental principles and theories related to classroom management approaches, reinforcement and punishment, and classroom rules and routines. • Students will discover applications of the course material to improve their decision making in choosing the most appropriate classroom management strategy or approach to deal with disciplinary issues. • Students will transfer theoretical knowledge to real life of the theories they learn through creating their own classroom management plan. • Students will appreciate the importance of creating a positive classroom environment which is conducive to learning.
Course Outcomes	A student who successfully fulfills the course requirements will have demonstrated an ability to: **CO1**: Identify approaches to classroom management **CO2**: Describe disciplinary problems in the classroom **CO3**: List the reasons behind disciplinary problems in class room situation. **CO4**: Generate practical and creative solutions to the disciplinary problems that teachers face **CO5**: Plan a personal classroom strategy **CO6**: Distinguish between classroom strategies used to prevent disciplinary problems and select the most appropriate one based on the situation **CO7**: Analyze observational findings of teaching / learning methodologies used in classroom situation.
Covered Topics	• **Classroom management & classroom discipline** • **Classroom rules and routines** • **Positive learning environment** • **Types of teachers and types of students** • **Motivation** • **Reinforcement & Praise** • **Consequences and punishment** • **Sources of problems in the classroom**

	• **Classroom management strategies and approaches** • **Parents' involvement** • **The noise level in classrooms**

Course Schedule

Week	Chapter/Reference	Topics
Week 1	**Lesson 1: The Act of teaching**	**a. Teaching as a complex/simple process** **b. Teaching as an art and as a science** **c. Teaching as a profession** **d. Reflective teaching** *Students write a reflection (in class) about their opinion whether teaching is a complex or a simple process and whether it is a science or an art*
Week 2	**Lesson 2: Classroom management vs Classroom discipline**	**a. Definition of Classroom Management and Classroom Discipline** *Students write a list of actions/strategies/measures that they think every teacher should take in order to effectively manage her/his classroom*
Week 3	**Lesson 3: Classroom rules and routines**	**b. Establishing classroom rules & routines** **c. Establishing a positive classroom environment** *Students come up with a list of at least 5 classroom rules based on the grade level they will teach*
Week 4	**Lesson 4: Types of students**	**a. Types of students** **b. Sources of problems in the classroom** **c. How to deal with the different sources of problems** *Students have to think of one problem that is usually common in classes. They need to think of its*

		reasons and how teachers should deal with it ***Quiz I (lessons 1 to 4)***
Week 5	**Lesson 5: Motivation: A key concept**	**a. Motivation: Intrinsic and extrinsic** **b. Punishment & Reinforcement** **c. Praise** *Students list some types of rewards/ consequences they might use in their classes*
Week 6	**Lesson 6: The teacher management styles**	**The permissive, the authoritarian, the indifferent, the laissez-faire, and the authoritative teacher** *Teacher can select an online questionnaire that students can fill to identify their management style.* *Teacher can come up with different classroom scenarios, and students have to tell how teachers with different styles will deal with each scenario*
Week 7	**Lesson 7: Writing a Contract**	**Contract** • *Members of the Contract and date to commence* • *State objective/target behavior* • *Student's role* • *Teacher's role* • *Parents' role (if available)* • *Rewards* • *Consequences* • *Date to renew or revisit* • *Signatures* • *Design & Neatness* *Contract has to be the product of students' work and a reflection of their creativity. Attempts to use a readily available one from the Internet will immediately result in a ZERO.* ***Quiz II: Lessons 5,6,7***
Week 8	**Lesson 8: Humanistic Orientation for classroom management**	**a.** **i. Power** **ii. Norm**

		iii. Awareness **b. The seven elements of effective classroom management** **c. General guidelines for effective classroom management**
Week 9	**Lesson 9: Approaches to classroom management**	**a. Kounin: overlapping, withitness, proximity, ripple effect…**
Week 10	**Lesson 9: Approaches to classroom management**	**b. Responding to minor, serious, and chronic misbehavior**
Week 11	**Lesson 9: Approaches to classroom management**	**c. Reality Therapy** **d. Imposed Discipline** **i. Desist Strategies** **ii. Assertive Discipline** *Students write reflection regarding their preferred approach to classroom management* ***Quiz III: (Lessons 8 & 9)***
Week 12	**Lesson 10: Parents' Role and Involvement**	**a. Parents' involvement** **b. Parents-teacher conference** *A teacher-parent conference : do's and the don'ts*
Week 13	**Lesson 11: Noise Level in the classroom**	**a. Noise: not so bad!**
Week 14	**Lesson 12: Token Economy**	• **Design &Theme** • **Rules** • **Tokens** • **Reinforcers**
Week 15	**Presentations of the Token Economy**	**Presentations** • *Creativity 2/10* • *Illustrations & Neatness 2/10* • *Rules 2/10* • *Tokens 1/10* • *Reinforcers 2/10* • *Theme 1/10* *Token Economy has to be the product of students' work and a reflection of their creativity. Attempts to use a readily available one from the Internet will immediately result in a ZERO.*

Assessment Methods & Grades Distribution

Assessment	Weight (%)
Participation activities (suggested above)	20%
Quizzes _ at least 3	25%
Assessments: Token Economy and Writing a Contract + 2 case studies	25%
Final Exam	30%
Total	**100%**

Textbook / References

Compiled book:
-Snowman, J. (2011), ***Psychology Applied to Teaching***, 13th edition, Houghton Mifflin, Boston, New York, USA. ISBN: 0-395-77685-6

-Orlick et al. (2007) ***Teaching Strategies: A guide to Effective Instruction***, 8th Edition, Houghton Mifflin, Boston, New York, USA. ISBN: 978-0618-66071

-Dunbar, C. (2004) ***Best Practices in Classroom Management*****,** Michigan State University, Michigan, USA, (available on line)

- Barnes, R (2006), ***The Practical Guide for Classroom Management***, Paul Chapman Publishing, London ISBN 10 1-4129-1939-8

– Garrett, T (2014), ***Effective Classroom Management: The Essentials***, Teachers College Press, New York, ISBN 978-0-8077-7323-9

- Marzano, R. et al. (2005), ***A Handbook for Classroom Management that Works*** Association for Supervision and Curriculum Development, Virginia, USA. ISBN 1-4166-0236-4

- Bluestein, J. (2014), ***Managing 21st Century Classrooms***, Association for Supervision and Curriculum Development, Virginia, USA. ISBN 978-1-4166-1885-0

EDUC631
Content Area Education for TESL Students
Graduate

Course Description (توصيف المادة):	This is one of the core masters courses in the Education Department. It is designed for all students pursuing their MA in TESL. The course is intended to prepare students to work collaboratively with teachers who are teaching different subjects in English. First, students will focus on certain theoretical principles related to the teaching of English through content and their practical implications. Later in the course, students will be introduced to the Sheltered Instruction Observation Protocol (SIOP) model which is one of the models mostly followed in the domain of Content-Based Language Teaching (CBLT). This course has no specific prerequisites. Also, it is not a prerequisite for any other course.
Course Objectives (اهداف المادة):	• It introduces the theory and practice of CBLT. • It helps students to develop a general understanding of research in the domain and the practical implications of CBLT. • It examines the SIOP Model.
Course Outcomes (مخرجات المادة):	A student who successfully fulfills the course requirements will have demonstrated an ability to: **A. Knowledge**: 1. CO-1. Define key terms that are central in the domain of CBLT (PLO1). 2. CO-2. Identify the different approaches used in CBLT and how they differ from each other (PLO2). 3. CO-3. Provide concrete examples on how teachers deal with the opportunities and challenges of CBLT (PLO2). **B. Skills**: 4. CO-4. Explore the possibilities and challenges of CBLT in a variety of setting (PLO2). 5. CO-5. Review studies done with CBLT learners of different age groups (PLO4). 6. CO-6. Utilize a variety of Content and Language Integrated Learning (CLIL) techniques to improve the students' learning of both content and the English language and translate the CLIL methodology into classroom practice that is suitable for the targeted age-group (PLO3). 7. CO-7. Prepare a unit taking into consideration the different CLIL features (PLO3). 8. CO-8. Design a detailed SIOP unit that reflects the 8 components of the model (PLO3).

	C. Attitudes: 9. CO-9. Promote student teachers' awareness towards the integration of academic language development into their teaching practice (PLO5).
Covered Topics (محتوى المادة):	• Introduction to CBLT • Approaches to CBLT • Learning Language & Learning Content • Using CBLT/CLIL with Primary Learners • Using CBLT/CLIL with Adolescent Learners • Reflecting on Research from CBLT/CLIL • Introducing the SIOP Model & Its Basic Features • Effective Use of the SIOP Model • Reflection on Content Area Research and Practice

Course Schedule

Week No.	Material to be covered	Resources	Course Outcome
1	Introduction to Content Based Language Instruction	Readings: Chapter 1 - Lightbown	CO1
2	Approaches to CBLT	Readings: Chapter 1 – Lightbown Chapter 1 & 2 - Mehisto et al. - Independent	CO2 CO3
3	Learning Language & Learning Content	Readings: Chapter 2 - Lightbown	CO6
4	Learning Language & Learning Content (Cont'd)	Readings: Chapter 2 – Lightbown Chapter 4 – Mehisto et al.	CO6
5	Using CBLT/CLIL with Primary Learners	Readings: Chapter 3 – Lightbown Chapter 3 – Part 1 – Mehisto et al	CO4 CO5
6	Using CBLT/CLIL with Adolescent Learners	Readings: Chapter 4 – Lightbown Chapter 3 – Parts 2 & 3 – Mehisto et al	CO4 CO5
7	Reflecting on Research from CBLT/CLIL	Readings: Chapter5 – Lightbown Chapters 5 & 6 = Mehisto et al	CO6 CO7 CO9

8	Reflecting on Research from CBLT/CLIL (Cont'd)	Readings: Chapter5 – Lightbown Chapters 5 & 6 = Mehisto et al	CO6 CO7 CO9
9	**Midterm**		
10	Introducing the SIOP Model & Its Basic Features	Readings: Chapters 1,2 & 3 – Echevarria et al.	CO8
11	The SIOP Model Basic Features (Cont'd)	Readings: Chapters 4, 5 & 6 – Echevarria et al	CO8
12	The SIOP Model Basic Features (Cont'd	Readings: Chapters 7, 8 & 9 – Echevarria et al	CO8
13	Effective Use of the SIOP Model	Readings: Chapters 11 & 12	CO8
14	Reflection on Content Area Research and Practice		CO9
15	Project/ Research Paper	Presentations	

Assessment Methods & Grades Distribution

Mark Distribution	
Participation	20%
Assignments	25%
Midterm	25%
Final Project / Research Paper	30%

Textbook / References

1. Essential Textbook:
   - Lightbown, P. (2014). Focus on Content-Based Language Teaching. Oxford University Press.
   - Echevarria, J., Vogt, M., & Short, D. (2017). Making Content Comprehensible for English Learners: The SIOP Model, 5th Edition. Pearson Education Inc., New Jersey.
2. Recommended Recourses:
   Mehisto, P., Marsh, D., & Jesus Frigols, M. (2019). Uncovering CLIL: Content and Language Integrated Learning in Bilingual and Multilingual Education. Macmillan Education, London.

Facilities required for teaching and learning

Digital copy of the Textbooks, PowerPoint presentations, Videos, Articles, Google Classroom, Google Meet, Zoom.