Influences of Self-Efficacy on Pre-Service Teachers' Use of Technology to Teach in Saudi Arabia

By

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Dedication

I would like to dedicate all my achievements, including this thesis, to several special individuals in my life.

First and foremost, this is dedicated to my wonderful father, Sabih and my beloved mother, Anza, who always aspired for me to have the opportunities they might have missed.

I also dedicate this success to my soul mate and loving husband, Aref Al-Saiari, whose unwavering support has been my anchor through the journey and to my cherished children who inspire me daily.

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(With the merciful, compassionate name of Allah)

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Glossary

Blackboard: Application for online teaching, learning, community building and knowledge sharing.

Computer Experience: Level of familiarity, skills and exposure an individual has with using computers and related technologies.

Computer Qualifications: Formal credentials, certifications, or qualifications that demonstrate an individual's knowledge and skills in using computers and related technologies.

Context Specific: Effectiveness or appropriateness of a particular approach or solution depends on the specific circumstances, environment, or context in which it is applied.

COVID-19: virus that triggered a world-wide pandemic in significantly disruptive in 2020 through 2022.

Curriculum Design: Planning and structuring the content, objectives and learning experiences in an educational programme or course to achieve specific learning outcomes.

e-Learning Education: Interactive environment through the use of computer technologies and the Internet that relies on the provision of educational (electronic) content that enables learners to actively interact with that content, with the teacher and with their peers, whether synchronously or asynchronously.

Educational Technology Programme (ETP): Structured initiative focused on integrating technology into education to enhance teaching and learning experiences.

EFL: English as a Foreign Language (qv).

English as a Foreign Language (EFL): Courses teaching English to students whose first language is not English.

ETP: Educational Technology Programme (qv).

ICT: Information and Communication Technology (qv).

Information and Communication Technology (ICT): Technology providing access to information through telecommunications, including computers, internet, mobile devices and software applications.

Integration of ICT in Higher Education Teaching and Learning: Incorporating and effectively using information and communication technologies in teaching and learning processes within higher education institutions.

Innovative Pedagogies: Creative and novel methods, approaches and strategies used by educators to enhance learning outcomes.

KSA: Kingdom of Saudi Arabia.

Learning Management System (LMS): software platform to deliver online education. Common examples are Blackboard (qv) and Moodle.

Madrasati: Learning Management System (qv) established by the Saudi Ministry of Education.

Matrix: Mathematical term (plural matrices) for a rectangular array of numbers, symbols, or expressions, arranged in rows and columns, used to represent mathematical objects or their properties.

Motivation: Internal or external factors driving individuals to engage in behaviours, pursue goals, or achieve desired outcomes.

Paradigms: Sets of beliefs, practices and assumptions guiding how people think, understand and interpret the world, particularly in the context of ICT (qv) integration in education.

Pedagogies: Methods, approaches and strategies used by educators to facilitate learning and teaching.

Perceptual Dilemmas: Challenges arising from conflicting perceptions or uncertainties that can impact decision-making and behaviour, often encountered in integrating ICT (qv) in education.

PPE: Professional Placement Experience (qv).

Pre-service Teacher (PST): Individual enrolled in teacher education program, undergoing preparation and training to become a teacher in future.

Professional Placement Experience (PPE): A programme that provides students with practical, hands-on experience in professional settings relevant to their field of study.

PST: Pre-service Teacher (qv).

SAMR: Technology usage model that categorizes technology usage into four levels: Substitution, Augmentation, Modification and Redefinition.

Self-efficacy: Belief in one's ability to successfully perform tasks or achieve goals, particularly in using ICT (qv) for teaching and learning.

SNS: Social Networking Site (qv).

Social Networking Site (SNS): Platform by which people form and maintain online relationships, both with others and with brands and causes such as Facebook®, YouTube, Instagram, WhatsApp and LinkedIn.

Teachers' Sense of Efficacy Scale (TSES): tool designed to measure teacher self-efficacy.

TPACK: Framework to understand the interactions between Technological knowledge, Pedagogical knowledge and Content knowledge, helping educators integrate technology effectively into teaching practice.

TSES: Teachers' Sense of Efficacy Scale (qv).

Vision 2030: *Saudi Arabia Vision 2030*, a vision document for Saudi Arabia (Kingdom of Saudi Arabia, 2022).

Conference Presentations

Alsaiara, A., Conner, L., & Le Lant, C. (2020). The relationship between self-efficacy and Saudi preservice teachers' use of technology. *Improving Education Settings HDR Conference 2020*, November 10, Flinders University.

Alsaiari, A. (2021). Azizah (PhD candidate, Education) presented How should universities adopt the TPACK and SAMR model to prepare pre-service teachers' qualification to use ICT: A review of the literature at the ATEA 21 Conference in Brisbane. Co-authors are Professor Lindsey Conner and Dr Carol Le Lant.

Declaration

I certify that this thesis:

1. does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any university

2. and the research within will not be submitted for any other future degree or diploma without the permission of Flinders University; and

3. to the best of my knowledge and belief, does not contain any material previously published or written by another person except where due reference is made in the text.

Signed.....

Date..... October 2024

Abstract

Implemented within an embedded sequential explanatory mixed-method embedded sequential explanatory mixed-method research framework, this study amalgamated quantitative and qualitative data to investigate how Saudi pre-service teachers utilised technology to improve student learning in the classroom and the associated impact on their self-efficacy. The quantitative phase involved data from 97 pre-service teachers at a specific university in Saudi Arabia, while the qualitative component scrutinised interview responses from 9 pre-service teachers. Findings revealed that Saudi pre-service teachers used ICTs in their lessons most especially at the enhancement level of SAMR and that they had high self-efficacy on technology integration. Results also revealed some problems they encounter while using technology in professional placement experience along with their suggestions on how to improve technology use. In addition, the study found that pre-service teachers with high levels of self-efficacy tended to use technology at the level of transformation, while those with intermediate or lower levels of self-efficacy tended to use technology at the level of enhancement. Based on the results, certain implications were drawn from the study in order to improve future teacher education programs that utilise technologies. The contribution of this study is significant because the developed measurement tools were innovative in their approach to ways of measuring pre-service teachers' sense of self-efficacy and of drawing out opportunities for developing technological competence, especially in a Saudi context. Of particular interest, the study suggested an alternative three-factor approach to evaluating pre-service teacher self-efficacy that combined classroom management and student interactions into a single factor. Such deviation from the commonly used-factor model provided a contemporary and comprehensive treatment of the relationship between these significant factors in terminology. Moreover, the study also brought up an absolutely innovative fourth factor that was been developed with one purpose: to assess how confident pre-service teachers were in were in integration technology into their teaching technology. This addition was an innovative contribution in that it reflected the changing nature of education technology and attempts to meet the specific needs and skills necessary pertinent to Saudi pre-service teachers. In addition, the research contributed to an analysis of current pre-service teacher education when it comes to evaluating educational technology. Through the

adoption of SAMR model as a lens for evaluation, this research demonstrated that use of educational technology in a Saudi pre-service teacher preparation programme was mainly at the enhancement stage rather than transformation phase. This insight was a useful revelation for educators, policymakers and researchers as it showed a need to apply some changes towards a more transformation-based technology implementation within teacher training programs. This study not only promoted progress in the development of outcome measurement tools, but also advocated for better quality teacher preparation programs aligned to constantly changing technology dynamics in education. These results provided enlightening information to teachers and the policy makers as well in Saudi Arabia, as well as the West Asia region.

1. Introduction to the Study

This chapter consists of the following sections:

- About This Study
- About the Researcher
- Significance of this Research
- Rationale and Problem Context of this Research
- Organisation of this Thesis
- Research Aim and Objectives
- Research Questions
- Chapter Summary

1.1 About This Study

Pre-service teacher (PST) preparation programs aim to prepare PSTs to become high-quality teachers equipped with pedagogical knowledge, skills and effective practices to meet the challenges of 21st century teaching and learning (Bihasa, 2022; Mergler & Spooner-Lane, 2012). A most significant development in the education systems of many nations has been the increasing integration of information and communication technology (ICT) in digital classrooms, in computer-assisted learning and in the teaching profession (Abbitt, 2011; McKnight et al., 2016; Polly et al., 2010). Integration of technology for teaching has accelerated with the growth of on-line digital learning tools, particularly during the COVID-19 pandemic (2020 – present), which necessitated closure of schools and a paradigm shift in education with the introduction of remote, on-line learning in many countries (Bozkurt et al., 2020; Haleem et al., 2022; World Health Organization, 2023).

Since the inception of Saudi Arabia Vision 2030 (Vision) (Kingdom of Saudi Arabia, 2022), several studies have focused on its different facets. All these studies have shed much light on the different aspects of the education system especially in Saudi universities that are related to Vision (Dhawi & Albaqami, 2017). Yet, few studies

have discussed the potential of higher education in line with Vision's Strategic Goals for Development of higher education subsumed under this vision document.

As a result, of higher education development has been placed at the basis of Vision objectives. The proposal discusses the HE strategic goals and are what these educational reforms have caused, as well as how the new scenery of Saudi Arabia's own higher education system has been developed such collaboration with foreign institutions. Indeed, Saudi Arabia holds a significant position within the Gulf region and stands as a potential case study for any country globally, particularly with its commitment to achieving the objectives outlined in Saudi Vision 2030. The nation boasts an oil-based economy, a sizable young population and is experiencing growth in the higher education sector. This landscape encompasses public universities, specialized vocational colleges and private higher education institutions (Ghulam & Mousa, 2019). The Saudi national qualification framework facilitates academic achievement in the vision's scheme and supports HEIs because of a wider sense of responsibility created for these entities concerning education development by objectives on which it is based (Mohiuddin et al., 2020).

In Saudi Arabia, a key objective set forth by the government's ambitious plan, *Saudi Vision 2030,* has been to raise the quality and professionalism of teaching by increasing the effectiveness of the use of technology in education to improve student learning outcomes (Al-Helayyil et al., 2016; Vietor & Sheldahl-Thomason, 2018). *Saudi Vision 2030* is a national development programme and strategic framework launched in April 2016, with the aim of diversifying Saudi Arabia's economy and reducing its dependence on oil and natural gas resources by increasing international investment and trade in other commodities while advancing human capital, health, education, recreation and tourism in the country (Saudi Vision 2030, 2022). Education, in particular, has been the focus of intense efforts to integrate ICT in schools and raise the competency level of teachers in incorporating technology into their classroom teaching. Consequently, there has been greater interest within Saudi Arabia in using pedagogical teaching practices that enhance self-efficacy in relation to the effective and increased use of technology.

During the COVID-19 pandemic, Saudi Arabia universities shifted away from traditional face-to-face classes and adopted online learning resulting in the exponential growth of online learning (Alammary et al., 2022). COVID-19 created

challenges for teachers due to a lack of preparation on the part of institutes, teachers and students for online learning. Educators at all levels of education are often technologically illiterate, which makes the sudden transition to e-learning complex for both the teachers and students to adapt to e-learning (Allam et al., 2020)

The pandemic tested professors', pre-service teachers (PSTs) and students' readiness to embrace and implement digital technologies in online classes (Allam, 2020). Since COVID-19 forced the implementation of technology in classrooms, educational institutions and students have been required to utilize advanced online information and communication technology to complete their tasks and carry out daily learning activities, to maintain social distancing protocols. Due to this, academic institutions have undergone a significant transformation, becoming more open to digital learning and embracing hybrid learning practices (Singh, 2021). The impact of these developments has been profound for both students and teachers. For students, digital learning has provided increased accessibility to educational resources, fostering a more personalized and flexible learning experience. Teachers, on the other hand, have had to adapt their instructional methods, incorporating technology into their teaching strategies and expand their roles as facilitators in the digital realm.

This transformative shift in educational practices sets the stage for exploring its correlation with academic self-efficacy among pre-service teachers. Research has consistently demonstrated that teachers with high levels of self-efficacy are not only open to new ideas but also exhibit a readiness to adapt to a range of technologies and pedagogical methodologies available to them (Fives & Manning, 2005; Tschannen-Moran & Hoy, 2001). As technology plays an increasingly integral role in education, studies on the use of ICT, including those in Initial Teacher Education (ITE), underscore the importance of adequately preparing pre-service teachers. These studies emphasize the need for equipping PSTs with the appropriate knowledge and skills for the effective use of technology in teaching (Andreasen et al., 2022; Gill & Dalgarno, 2017; Santos & Castro, 2021).

Furthermore, the relationship between the transformative nature of digital learning and teachers' adaptability to technology extends to pre-service teachers' personal qualities. Pre-service teachers with higher self-efficacy are more likely to exhibit persistence, showing resilience in the face of challenges and a continual striving to accomplish their goals (Adams et al., 2020; Lee et al., 2020). This persistence aligns

with the demands of the evolving educational landscape, where the ability to navigate and overcome obstacles is increasingly crucial for success. Understanding these dynamics is paramount for enhancing the academic self-efficacy of pre-service teachers and preparing them for the multifaceted challenges of modern educational environments.

1.2 About the Researcher

The development of education is widely recognized as a crucial learning process that extends beyond the mere delivery of information. While the primary goal of education remains to impart knowledge, it is equally important to acknowledge that education involves fostering critical thinking, problem-solving skills and a deeper understanding of the subject matter (Larsson, 2017) However, a range of factors influence the pedagogy of teaching, including learning theories and research evidence, political and cultural drivers, educators' experiences and expertise and community expectations, all of which are continually changing (Alammary et al., 2022). Consequently, educators must keep pace with rapidly evolving pedagogical methods and technological advances that can enhance outcomes for learners and the performance of the education system more broadly. Despite the transformational changes in teaching methods at the global level over the past several decades and the widely available knowledge about improved teaching methods, in-service teachers and pre-service teachers in Saudi Arabia have continued to adopt traditional teacher-centred, rote-learning methods in their classrooms (Albahiri & Alhaj, 2023; Alkahtani, 2017; Allmnakrah & Evers, 2020).

As a faculty member at two Saudi universities during 2014–2017, I taught pre-service teachers in topics ranging from computers in education, teaching techniques and technology and principles of educational research. I was also responsible for supervising 20 pre-service teacher students during their first professional placement experience in schools in Sharurah, Saudi Arabia.

The ability of pre-service teachers to restructure learning, integrate technology effectively with pedagogy, create socially engaged learning environments and promote cooperative engagement will be key to the success of ICT integration into the learning environment. In my teaching, I found that among the educational programs, the pre-service teachers focused on the use of educational technology as a tool, not to

create an interactive, collaborative environment, but to replace traditional textbook and pen-and-paper tools. Later, I discovered that these pre-service teachers rarely acquired the skills or developed the self-efficacy to incorporate ICT into their future classrooms, even after they had been engaged in learning some of the information and skills necessary to do so. Hence, the nature of this problem and the complexity of resolving obstacles to developing digital competency in Saudi teachers led me to undertake further academic study for a PhD and conduct research on this topic.

In 2019, I realised as an academic that my PhD study would open up horizons for me and give me the opportunity follow my passion and learn more about this field. The PhD journey is an opportunity and a major transformation in my academic field. After obtaining the Saudi scholarship for faculty members to continue doctoral studies, I chose to study abroad at an Australian university because Australia enjoys a strong reputation in Saudi Arabia as a leader in the educational and academic research environment in my field of study.

In 2020, at the beginning of my doctoral studies and despite the outbreak of the COVID-19 pandemic, I did not experience any difficulty in commencing my PhD candidate program, as the tertiary education system in Australia was prepared to start remotely in such a crisis. I experienced the qualitative shift and the flexibility of the College at that time and a significant difference between the Saudi system and the Australian system in terms of providing programs via distance education, including online communication and student evaluation. However, the Saudi system and especially the university in which I work, needed many adjustments and modifications to match the Australian system, which constructs the teacher education system on practical, evidence-based preparation.

1.3 Significance of this Research

Several researchers (for example: Buric & Kim, 2020; Hatlevik, 2017; Peciuliauskiene et al., 2022; Pozas et al. 2022) have argued that, due to a lack of self-efficacy in using ICT, PSTs may not have the confidence to effectively use technology in their teaching. Therefore, PSTs need mastery experiences to improve their self-efficacy in technology integration, which would be most effectively achieved through practise during their undergraduate degree (Bandura, 1986, 2001). This can involve self-paced exploration of technology, review of ICT-integrated

lessons, or hands-on designs using ICT (Koh & Divaharan, 2011). In terms of teacher preparation, limited research on the benefits or impact of self-efficacy on PSTs' use of ICT can be found in the literature (Buric & Kim, 2020; Hatlevik, 2017; Peciuliauskiene et al., 2022; Pozas et al. 2022. The most common view in the literature suggests that a teacher's level of self-efficacy does indeed affect technology integration (Birisci & Emin, 2019; Gomez et al., 2022; Martin, 2020). Therefore, this research has significant pedagogical meaning and purpose that recognises the potential connection between self-efficacy and ICT use by PSTs. A thorough examination of the published literature had not found any studies from Saudi Arabia in this specific area of research. Therefore, this study may be the first to shed light on the relationship between self-efficacy and ICT and how PSTs integrate ICT into their planning and teaching in the Saudi Arabia context.

1.4 Rationale and Problem Context of this Research

The location of this study is a university situated in the southwestern region of Saudi Arabia. The university is located in a province near the border with Yemen. In the selection university's Field Placement Course, the student must successfully pass all the previous degree content in the Initial teacher education program. On completion of this criteria, the pre-service teachers are placed in schools and distributed according to the need of schools in the region and matched to the specialisation(s) of the pre-service teachers. In Saudi Arabia, pre-service teachers who specialise in Pre-school education are distributed to kindergarten and pre-school education (learners aged 3-6), pre-service teachers who do not specialize in kindergarten are often sent to secondary levels, which are grades 7-9 and high levels, which are grades 10-12. Female students are assigned to schools by the regional education department.

At the same time as the Field Placement experience, pre-service teachers are enrolled in an Educational Technology Programme where they are explicitly taught how to incorporate ICT in their teaching. This programme is compulsory in the final semester of study for all PSTs attending in the selected university. While the programme provides basic theoretical information on how to use ICT tools, it does not currently consider the pedagogical implications.

This is where the concept of Technological Pedagogical Content Knowledge (TPACK) becomes relevant. TPACK is a framework that emphasises the intersection

of technological knowledge (TK), pedagogical knowledge (PK) and content knowledge (CK). In the context of pre-service teacher education, TPACK highlights the importance of understanding how to use technology (TK) in the specific context of teaching a particular subject (CK) with effective pedagogical strategies (PK).

Even though TPACK-related programs are increasingly being implemented for pre-service teachers around the world, there have been very few studies that explore their role in enhancing their self-efficacy to use technology in their teaching practices (Alshawaf, 2020). Moreover, teachers were hindered in supporting PSTs or evaluating student performance when their conventional, in-person teaching methods were supplanted by online remote learning modalities with which they were unfamiliar (World Bank, 2020, 2022).

Pre-service teachers (PSTs) confront significant challenges in adapting to technology, leading to a range of issues that extend to their interactions with school students. The struggles faced by PSTs, as highlighted by Al-Abdullatif (2019), stem from the neglect in addressing how to appropriately use technology and the lack of emphasis on leveraging technology to enhance student cooperation and learning. These challenges ripple into the experiences of school students during the COVID-19 pandemic, where difficulties accessing online course content and teaching support persist due to inadequate digital devices, poor Internet connectivity and the unavailability of prepared digital learning materials. As noted by Bozkurt et al. (2020), school students in Saudi Arabia grapple with constraints on social and academic interactions, distance relationships with teachers and the subpar quality of online educational resources.

Moreover, this predicament extends to the mentoring process, where teachers guiding PSTs face additional hurdles. The insufficient integration of technology in higher education exacerbates the issue. In the Kingdom of Saudi Arabia, specialized educational programs to develop digital technology competency for PSTs are lacking and preparation courses that facilitate seamless technology integration are notably absent. Contributing factors include inadequate access to technology, limited training opportunities and time constraints, as outlined by Almaiah et al. (2020) and Alammary et al. (2022). This interconnected web of challenges underscores the critical need for a comprehensive approach to address the technological gaps in both pre-service teacher education and the broader educational landscape.

It could be considered that this limitation may not have existed to such an extent if Saudi PSTs had experienced opportunities to master effective technology integration during their pre-service university courses. Therefore, it could be argued that ICT integration into teaching is an area needing attention in Saudi pre-service and in-service teacher education opportunities, thereby better preparing the Saudi teaching profession for the kinds of unpredictable eventualities the education system may face in the future. The main reason I used case studies was to demonstrate how pre-service teachers adapted how they used and applied technology to different science subjects and different year levels.

1.5 Organisation of this Thesis

This thesis follows an extended thesis format as described by Creswell and Plano Clark (2018). In order to conceptualise the thesis, I used critical social constructivism. Because of this, the thesis structure illustrates the process of my iterative research. Throughout the chapters, context is first provided, followed by breadth and depth and then the research question is addressed.

Chapter One presents the purpose of the study, including an explanation of the problem and the significance of the research. This chapter outlines the aims of the thesis and provides a purpose for the thesis.

Chapter Two presents the context of pre-service teachers' education in Saudi Arabia. My intent in this chapter is to present an overview of the Saudi Teacher Education system. I discuss the use of technology in teacher education planning and teaching, the online environment for teacher training, the history and policy of pre-service teacher education in Saudi Arabia, as well as the history and practices of international education technology for pre-service teachers.

Chapter Three examines the relevant literature related to self-efficacy in initial teacher education. Throughout the chapter, various aspects are discussed, including professional placement experience and support in this domain. Furthermore, it discusses key educational issues associated with technology integration, educational change and ICT policy in the context of teacher professional development. Within this discussion, the TPACK framework and SAMR model are thoroughly explored, shedding light on their significance in facilitating effective technology integration.

Additionally, the chapter investigates the internal and external factors that influence teachers' ICT utilisation in classrooms, providing a comprehensive analysis of the subject matter. This literature review serves as a foundation for the subsequent chapters, offering valuable insights and identifying gaps in knowledge where my study will contribute.

Chapter Four details the methodology and research design. I outline critical realism, discussing main concepts and explaining why it is relevant for the discussion. Secondly, I describe the theoretical framework of my research. This critical realist framework informed my interpretations and analysis of the qualitative data. Lastly, I discuss the embedded sequential explanatory mixed-methods design and its reasons to be preferred.

The quantitative phase of the study is presented in Chapter Five. In the first part of this chapter, I begin by laying out relevant literature for my quantitative study. Then, I present validation and reliability testing of measures then methods followed by the findings as a stand-alone study. This includes the methods of data collection particular to this stage and the characteristic of sample. Finally, I describe qualitative study outcomes revealing psychological empowerment within the sample and observing aspects correlating it. I also investigate the amount of variance in self-perceived response to change among practitioners that is accounted for by their psychological empowerment. The chapter ends with a short theoretical consideration of the consequences. In this chapter, my aim is to provide for breadth by describing the trends and correlations in multiple respondents.

In Chapter Six, I present the qualitative findings. The results are examined using the theoretical framework based on frameworks used. In this chapter, through participant narratives, I provide depth, bringing personal experience and reflection to the phenomena studied.

In Chapter Seven, I discuss the results of this study during its last phase in more detail. Throughout this chapter, I carefully introduce and analyse outcomes obtained from the two previous chapters. Quantitative results are reconstructed and clarified separately from the qualitative outcomes presented in Chapter Six. In analysing the data, I draw on relevant theories that let me go beyond superficial remarks, searching for deeper motivations, consequences and reasons. This chapter not only presents the

findings but also provides a more profound meaning, so that an integrated argument is developed in this way and an elaborated answer to the research questions can be made.

In Chapter Eight, which is the conclusion chapter, I give a general overview of the major outcomes related to research question. This chapter summarizes the results of the research, describing what this knowledge can mean for pre-service teacher practice as well as systemic technological usage. Moreover, I give recommendations for further research based on the consideration of a systematic analysis of weaknesses in this study. This dual-purpose chapter aims to bring together the key insights, draw practical implications and chart a course for potential avenues of further investigation in the field.

1.6 Research Aim and Objectives

The primary objective of this study is to gauge the self-efficacy of Saudi pre-service teachers and examine its correlation with technology utilization in the classroom. Utilising a rigorously tested instrument featuring high reliability coefficients and robust construct validity through factor analysis, the study endeavours to elucidate the technological pedagogical and content knowledge (TPACK) of pre-service teachers. This understanding is pivotal for comprehending how digital technology can be strategically integrated to transform classroom-based learning, employing the Substitution, Augmentation, Modification and Redefinition (SAMR) model. As Terada noted:

> A powerful conceptual tool to think about technology integration and edtech's best uses—is the SAMR model, developed in 2010 by education researcher Ruben Puentedura, who was the 1991 recipient of a Phi Beta Kappa teaching award. Using the SAMR model, teachers often focus on the first two levels of switching to an online format, which involve the replacement of traditional materials with digital ones: converting lessons and worksheets into PDFs and posting them online or recording lectures on video and making them available for asynchronous learning (Terada, 2020, para. 4).

TPACK and SAMR are described in detail in Chapter 2.

The study seeks to offer valuable insights into the barriers that impede pre-service teachers from developing a nuanced understanding of the constructs influencing their planning and teaching practices. By doing so, it aims to provide suggestions and recommendations that can inform the design of more effective technology-informed teacher education programs. While extending beyond the initial study aims, this approach is crucial for fostering a more nuanced understanding of the complexities surrounding pre-service teachers' engagement with technology.

This research holds the potential to contribute significantly to initial teacher education programs, technology utilization in education and the development of teachers' education policies in Saudi Arabia. It introduces a novel method for measuring Saudi pre-service teacher self-efficacy and technology use, thereby enriching the existing literature.

Therefore, the objectives of this research are as follows:

1, To assess and measure the self-efficacy of Saudi PSTs in using technology in the classroom.

2. To establish the ways in which PSTs use ICT, use ICT and the effect of exposure to the TPACK framework and SAMR model on how PSTs utilised ICT in their teaching.

3. To determine the effect of both self-efficacy and understanding of the TPACK framework and SAMR model on technology use of Saudi PSTs.

1.7 Research Questions

In order to identify, understand and study the factors influencing Saudi pre-service teachers' self-efficacy, the following research has been conducted:

Research Question 1 (RQ1)

- Do Saudi pre-service teachers perceive they have sufficient level of knowledge, experience and self-efficacy to be classroom-ready to teach with technology.

Research Question 2 (RQ2)

- How do Saudi pre-service teachers adapt the use of technology in their classroom through participation in educational technology programme (ETP) and professional placement experience (PPE)?

Research Question 3 (RQ3)

- Does Saudi pre-service teachers' self-efficacy change through the participation in a ETP and PPE if yes, what drives this change? If not, what are the potential reasons for this?

Following the examination of these objectives, the study provides a set of suggestions and recommendations. These insights aim to overcome barriers hindering pre-service teachers from developing a nuanced understanding of the constructs influencing their planning and teaching practices. The suggestions and recommendations will contribute valuable guidance for the design of more effective technology-informed teacher education programs. This research has the potential to significantly impact initial teacher education programs, the use of technology in education and the development of teacher education policies in Saudi Arabia. Additionally, the study introduces a novel method for measuring Saudi pre-service teacher self-efficacy and technology use, contributing to the existing literature in this field.

1.8 Chapter Summary

The first chapter of this thesis provides a background to the study, including a justification for the study and explanations of specialized terminology. While technology has been shown to benefit education and teachers have been using it more and more, Saudi pre-service teachers' self-efficacy in using technology has not been assessed. By focusing on both the knowledge and skills necessary for successful technology integration, as well as the pedagogical strategies needed to transform teaching and learning, TPACK and SAMR provide complementary frameworks that can help teachers integrate technology effectively in their teaching. TPACK and SAMR are described in detail in Chapter 2.

2. Teacher Education in Saudi Arabia

This chapter contains the following sections:

- Introduction
- Social Constructivism
- Saudi Arabian Context
- Lessons from COVID-19 for Pre-Service Teachers
- Barriers to Technology Integration
- Summary of Saudi Arabian Context
- Chapter Summary

2.1 Introduction

The main purpose of this study is to explore pre-service teachers' self-efficacy in Saudi Arabia and contextual variables that contribute with their level of technological confidence and attitude towards technology. This chapter provides relevant background information that is necessary for the current research, providing readers with knowledge of the scope of study and nature studies' design; teacher education environment in Saudi Arabia; online milieu within teacher education realm, technology integration into planning component and delivery methodology class lessons perspectives on beforehand teachers schooling system contexts structure for pre-service professional education.

2.2 Social Constructivism

Social constructivism emphasises the importance of social and cultural aspects in building and sharing knowledge, as it considers that learning occurs in a social context (Duit, 1998). From a social constructivist perspective, learning is an active process that involves interactions with others through culture and cognition (John-Steiner & Mahn, 1996; Jones & Brader-Araje, 2002; Vygotsky, 1978). This perspective suggests that isolated learning may not lead to cognitive growth and that social interaction is a precondition for such growth. To achieve the level of potential growth through social interaction, Vygotsky (1978) emphasised the importance of

providing support that enables the learner, in partnership with others, to accomplish what they cannot accomplish on their own and that this support is relevant to the goals of the learner. During this support process, the learner is guided to organise their learning so they can move through a series of steps that lead to cognitive growth and self-regulation of learning (Bandura, 2002).

This research adopts a social constructivist perspective to support pre-service teachers to integrate of technology effectively and to understand how that support is achieved. According to Crotty (1998), information and meaningful truth are created, formed and communicated in a social context. Therefore, the researcher develops acquisition of knowledge in this study by observing and evaluating the participants' experiences through analysing interactions between participants in focus group discussions. The social constructivist perspective is usually associated with qualitative research; however, it can also be applied to mixed-methods research design, as is the approach taken with this research. Therefore, adoption of a constructivist perspective has allowed the researcher to address the research questions in a way that enables a rich description of the data from participants (Creswell, 2003) since the concept is focused on comprehending the world of human experiences (Cohen & Manion, 1994, p. 36).

2.3 Saudi Arabian Context

This section consists of the following sub-sections:

- Introduction
- Overview of Education in Saudi Arabia
- Education Performance in Saudi Arabia
- Higher Education and E-learning in Saudi Arabia
- Women in Saudi Education
- Initial Teacher Education in Saudi Arabia
- Elements of Initial Teacher Education

2.3.1 Introduction

This research investigated the preparedness of pre-service teachers to integrate technology into practical application within initial education programs in the

Kingdom of Saudi Arabia (KSA). The Kingdom, governed by a monarchy and having a constitution rooted in Islamic regulations (Oyaid, 2009), experiences the pervasive influence of Islam in various aspects of life, with education standing out as a primary domain (Nuriman & Fauzan, 2017). Education, according to Islamic teachings, is not solely an academic pursuit but also a religious obligation, emphasizing the inseparable link between religion and education in the Saudi context (Albugami & Ahmed, 2016).

Within this intricate relationship, the educational objective extends beyond academic development to encompass the nurturing of Islamic religious consciousness. Moreover, as the research unfolded, the impact of cultural factors on online learning in this context became apparent, such as the presentation style of the curriculum, individualized educational approaches and the dynamics between teachers and students (Jesson & Peacock, 2012).

Saudi Arabia has undertaken comprehensive reforms to enhance women's participation in economic development (Al-Shamrani, 2013), including standardizing the retirement age and preventing gender discrimination in areas of work. In education, the Ministry of Education presented development initiatives to improve the environment for female teachers, emphasizing the role of women as leaders and appointing them as official spokespersons for the ministry. These reforms are further discussed in this chapter.

2.3.2 Overview of Education in Saudi Arabia

The history of education in Saudi Arabia reflects a transformative journey from traditional learning methods to a modernized educational system. Pre-1930, formal education was nearly non-existent, with the primary mode of instruction taking place in Kuttab, where basic skills such as Arabic letters, Islamic studies and Quranic recitation were taught in homes or mosques, employing gender-segregated teaching. The educational landscape underwent a substantial transformation in 1953 with the establishment of the Ministry of Education, resulting in a notable surge in student enrolment.

Saudi Arabia has a rule that children must attend school until they are 17 years old, beginning with grade 1 at the age of 6, with pre-school available at earlier ages. The education system is structured into three main levels:

- Early childhood (pre-school) and Primary (grades 1 through 6).

- Middle (grades 7 through 9).
- High school (grades 10 through 12).

Creation of the Ministry of Education in 1953 was very important for deciding how compulsory education works in Saudi Arabia and administers development, review and implementation of education rules. The Ministry makes sure that all children can access education and provides guidance about the curriculum content and structure. Commencing in 2006, Saudi Arabia introduced significant developments in the field of e-learning (Mokali, 2012), marking a crucial turning point in the country's approach to education by introducing technology-driven learning methodologies.

In 2007, recognizing the potential of e-learning, the National Center for E-Learning and Distance Education was established (Albalawi, 2007). This institution played a pivotal role in advancing technology-enhanced education within the Kingdom, indeed playing a big role in making education more modern across the country. The institution supported the use technology for learning in school, with special emphasis for online classes. Implementation of e-learning programs extended to students of all age groups, including those within the school-age bracket, fostering a more inclusive and technologically enhanced approach to education.

E-learning brought significant changes to teaching through the incorporation of digital technology into standard classrooms and offering students numerous learning opportunities outside a physical school setting. It was a transformative action that sought to facilitate more effective learning experiences for children and students at various teaching levels starting from mandatory education. In the same year, Saudi television channels started airing educational programs with assistance from the Ministry of Higher Education. Although these programs were not actual distance learning courses, they proved to be helpful resources, aiding students in the traditional learning system (Albalawi, 2007). By 2008, e-learning in Saudi Arabia was still considered to be in its nascent stages, with limited information available about its use (Al-Harbi, 2011). Despite this, the Saudi government recognized the importance of technology in education and called for a national plan to adopt information technology across the country (Chanchary & Islam, 2011). This plan recommended the implementation of e-learning and distance learning while envisioning future applications in higher education.

The COVID-19 pandemic highlighted the importance and value of e-learning, changing from an auxiliary means of helping the learning process to an essential solution for delivering education. This shift was underscored by the suspension of traditional educational methods and the imperative to adopt alternative approaches (Al-Azam, 2021; Aldossry, 2021). This transition heralded an era of alternative education, in which the continuity of learning and teaching processes was upheld through the medium of distance e-learning. Given the continuous development in the distance education process in education in general in the Kingdom of Saudi Arabia and in Saudi universities in particular, the infrastructure was in place for distance e-learning by the onset of the pandemic, including, for example, deanships specialized in e-learning. Electronic educational platforms had been (and continue to be) developed, with university websites having administrative and academic functions, spreading a culture of electronic interactions and e-learning (Al-Azam, 2021). Benefits of the various educational platforms included the training of both students and faculty, male and female to use them (Al-Azam, 2021).

2.3.3 Education Performance in Saudi Arabia

Education of the Kingdom of Saudi Arabia has had extensive quantitative progress increasing access to education. In 2017, the net enrolment rate was as high as 95.7% at primary education level, 88.7% in middle school and of 85.4% for secondary education (Ministry of Education, 2020). These figures compare well from a worldwide perspective.

A government focus on higher education institutions, through huge financial resource allocation, resulted into the increase of university from eight in 2000 to the current 28 in 2023 (Ministry of Education, 2020). More importantly, private sector participation has increased where there are now more than 50 private higher education institutions, including colleges and universities, compared to none in 2000. As a result, the general enrolment rates in higher education increased from 20.61% in 1999 to 64.1% in 2017, putting Saudi Arabia among high-income countries (with a 2017 average of 77.13%) and above countries with medium income (52%) and global averages of all continents combined (UNESCO, 2018).

Despite these quantitative improvements and extremely liberal spending, indicators of the quality of education in Saudi Arabia have been below aspirational standards,

showing levels of performance of students lower than international comparisons (Ministry of Education, 2020). A deterioration in educational quality represents a threat to the competitive power of Saudi Arabia, as economic productivity depends on well-educated human capital. In addition, quality education is a key component of economic growth.

Ministry of Education argued (2020, p. 15) that one of the major factors responsible for the lack of quality education is inefficacy of teacher preparatory programs. A prominent symptom of low efficacy is poor pass rates in the competence exams conducted by the National Center for Measurement, in which mean scores for test takers were 43% and 37% (educational and specialized components respectively), below the minimum requirement of 50% in both tests.

Low self- confidence requires an emphasis on improving teacher preparation programs and engaging in effective teacher recruitment and training policies. In essence, the efficacy and functionality of any educational establishment depends on the level of professionalism as well as productivity that teachers can achieve (Ministry of Education, 2020). A study reveals that teacher experience has the largest effects on student achievement, to the extent that the difference was estimated at two years in academic achievement between a learner who learns with a good teacher and a learner who learns with a not-so-good teacher (Cowan & Goldhaber, 2016).

Effectiveness of educational systems, for example, those found in Singapore, Finland and Korea (to which Saudi Arabia looks for comparison), is due to stringent teacher selection processes that guarantee high cognitive performance of those teachers (Hanushek et al., 2019).

Though Saudi Arabia has been very successful in achieving quantitative growth in education, it is desirable that attention should be given to a more qualitative improvement of teaching by addressing deficiencies in teacher preparation programs and introducing effective recruitment and training procedures.

2.3.4 Higher Education and E-learning in Saudi Arabia

The Kingdom of Saudi Arabia has been proactive in transforming its higher education system by adopting e-learning and distance learning. This transformative programme progresses along two paramount trajectories. First, the creation of independent universities, such as the Saudi Electronic University in 2012, in which there has been

a specialized place for higher education providing enriched environments for ICT, e-learning and distance learning. Governed under a dedicated deanship, the Saudi Electronic University institution controls all aspect of e-learning including infrastructure and operations (Al- Rashoud, 2015).

Additionally, two traditional institutions have changed to become dynamic e-learning and distance education centres: Imam Muhammad bin Saud Islamic University and King Abdulaziz University. These institutions enable graduates to specialize in e-learning and distance learning, foreshadowing an innovative trend in education (Al-Rashoud, 2015). Capitalizing on this innovation, a number of other leading organizations (such as King Saud University, King Fahd University for Petroleum and Minerals and Imam Muhammad bin Saud Islamic College) have instituted e-learning deanships. These innovations suggest that there is a focused determination to incorporate e-learning as part of the larger scenarios of a knowledge society and e-government programs, illustrating the commitment on behalf of the nation in moving ahead with education development during digital times. Afterwards, other contemporary universities have adopted e-learning by capitalizing on its advantages, regardless of whether it is under synchronous or asynchronous formulation in the classroom environment. This indicates the flexibility of e-learning methods, which can be implemented in real-time within traditional classrooms or accessed remotely at different locations and times.

2.3.5 Women in Saudi Education

Saudi women were elevated in business settings in Vision 2030 (Kingdom of Saudi Arabia, 2022), offering them improved conditions for participation and engagement in the workforce. Underpinning this development strategy were some challenging statistics: of the 50% of women who graduate from university only 22% of this gain employment. Reforms were therefore implemented to address such employment rates, including stimulating the Saudi society to empower women with a professional development programme designed to provide academic courses and on-the-job training for graduates to facilitate entry into the professional sector and to calibrate their skills (Rizvi & Hussain, 2022, p. 3). Launching a series of educational and development programs aimed at improving the working environment for women in the educational field.

These efforts come within the framework of the National Programme for Educational Development. The Ministry of Education presented a pioneering initiative aimed at improving the professional and educational practices of female teachers, with a focus on eliminating professional isolation and enhancing communication and interaction between them. The initiative included a series of lectures, seminars and workshops that included teachers in all regions and governorates of the Kingdom (Rizvi & Hussain, 2022). In addition, the Kingdom appointed a woman to be the official spokesperson for the Ministry of Education for the first time in the history of Saudi education. This step reflects the Kingdom's belief in the role of female leadership and enhancing female representation in high-ranking positions. A report further analysed that although these bold reforms fundamentally improved women's rights in multiple ways, there was still room for improvement (Almunajjed, 2013).

These steps reflect the Kingdom's commitment to enhancing the activation of the role of women in the educational field and achieving diversity and excellence in the field of education with the effective participation of women in presenting and developing the educational process.

2.3.6 Initial Teacher Education in Saudi Arabia

Teacher preparation programs in the Kingdom of Saudi Arabia (KSA) have undergone significant changes both before and after the start of the COVİD-19 pandemic. Historically, students seeking to enter the teaching profession in KSA after graduating from high school, enrolled in colleges affiliated with universities. Teacher preparation programs were offered to university graduates ranging from diplomas and master's degrees for non-educational subjects. Twenty-nine public universities provide teacher education programs in the KSA, and students are usually enrolled for at least four years of study according to the Ministry of Education (MOE) (Ministry of Education, 2020). Teacher education programs usually take one to two years in addition to other graduate studies.

A sequential system and an integrated system are both used for teacher preparation in KSA. In the sequential system, students enrol after completing their university education in a specialization, then undertake a further one to two years of study in Colleges of Education to earn an Educational Diploma or a professional master's degree. In contrast, the integrated system enables students to simultaneously study

teacher education and specialized courses over four years (Abuhamid, 2015). After graduation, prospective teachers are required to undergo teacher competency tests (mentioned in Section 2.3.3), consisting of a general exam covering various educational fields and a specialty test specific to their chosen subject area (Abuhamid, 2015).

Entrance into teacher training institutions in KSA (Kingdom of Saudi Arabia) is contingent upon meeting particular criteria. Applicants in the integrated system must possess a High School Certificate, while those in the sequential system should hold a bachelor's degree. Additional prerequisites encompass maintaining good conduct and demonstrating medical fitness. Certain universities may also consider the percentage of high school or bachelor exam results, along with performance in ability tests administered by the National Center for Assessment (Qiyas) (Al-Hazza, 2018).

Teacher preparation in KSA is structured into three key aspects: scientific (academic), professional (educational) and cultural (general) preparation. The scientific aspect entails in-depth study of one or more majors in the humanities fields that teachers will later instruct. The depth of specialization requires teachers to stay current with recent developments in their area of expertise. The professional aspect includes educational and psychological courses to prepare teachers for their roles and field training, which is an essential component of their professional preparation. Finally, the cultural aspect aims to develop teachers' awareness of their community's culture, problems and relationships (Altwaijri & Almuhaimeed, 2017). Assessment of students in teacher preparation programs involves various methods, including written tests, research, presentations and other relevant coursework. Additionally, students typically undergo written examinations at the end of each semester to evaluate their progress (Al-Hazza, 2018). Practical education, a crucial component of teacher preparation, is provided by Colleges of Education. It is accepted that pre-service trainee students undergo practical classes in their final year or during enrolment to educational diploma programs at designated public and private universities. The target population of this specialized training are bachelor's degree holders aspiring to become teachers (Al-Hazza, 2018).

Schools and universities in Saudi Arabia temporarily closed due to the Covid-19 pandemic. Following the outbreak of the pandemic, the Ministry of Education and education institutions responded quickly to the situation, ensuring the ongoing

functionality of the educational system crucial to the initial preparations for e-learning. Teaching methodology in institutes and universities was also transformed due to the lockdown (Ministry of Education, 2021). While e-learning solutions made teaching and learning possible in this situation, engagement proved to be an issue, with policy makers trying to solve it as well as tackling related digital disparities. Before being exposed to high stakes of preparing students for K-12 standards, teachers needed opportunities to explore these platforms and experience success in them (Cardullo et al., 2021).

With the onset of the Covid-19 epidemic, the Kingdom of Saudi Arabia, particularly the MOE and education institutions, swiftly responded to the crisis. The initial preparations for e-learning played a crucial role in ensuring the ongoing functionality of the educational system. The Ministry of Education, through Saudi universities, demonstrated the efficacy of e-learning and effectively addressed the crisis, allowing students to continue their studies (Ministry of Education, 2021). Educational provision continues through alternative means such as television, online resources and instructional packages (Mann, 2020). When the Saudi Arabian government responded to the crisis, local education authorities, principals and teachers were particularly active in providing distance education, such as Ain and Madrasati, to support students and teachers during the period of school closure. Officials believed Saudi Arabian students did learn under these circumstances but did so more slowly because fewer subjects were being taught (Mann, 2020). As noted by Mann (2020), this was a common perspective among education ministries worldwide.

Furthermore, a record number of schools faced closures necessitating an abrupt shift from face-to-face teaching to emergency remote teaching, as highlighted by Tarkar (2020) and Yi and Jang (2020). The unprecedented nature of this change led to the swift adoption of e-learning platforms. Notably, the consequences of this unexpected transition were initially uncertain and posed challenges for educators who were navigating this uncharted territory. The education system underwent a drastic transformation and as observed in a study by Cardullo et al. (2021), the complexities and implications of this shift became subjects of exploration, revealing the multifaceted impact on both educators and students. Despite commendable efforts to adapt positively, variations persisted among programs concerning their duration,

content and course offerings. This raised concerns about the overall consistency and clarity of teacher preparation throughout the country.

2.3.7 Elements of Initial Teacher Education

As it is a requirement in Saudi Arabia for pre-service teachers to comply with the guidelines associated with teaching with technology, as they will be at schools for their placements. They are usually expected to have the same technology knowledge and skills as their in-service colleagues.

Darling-Hammond et al. (2017) conducted a systematic review, searching literature from 2010 to 2017, focussing on identifying elements of effective teacher professional development through rigorous methodologies with positive impacts on student outcomes. After examining more than 30 studies, it was found that there were common elements of effective teacher education programs in the United States, which included the following features:

- Alignment with Education Standards: The programme aligns with national and state education standards and prepares students to meet certification requirements.
- Field Experience: The programme provides students with experience, allowing them to apply their knowledge and skills in real-world settings.
- Multicultural Perspective: The programme incorporates a multicultural perspective to prepare teachers to work with diverse student populations.
- Pedagogical Knowledge: The programme emphasizes the development of pedagogical knowledge and effective teaching strategies.
- Assessment and Evaluation: The programme includes instruction on assessment and evaluation practices and how to use data to inform instructional decisions.
- Technology Integration: The programme prepares teachers to effectively integrate technology into the classroom and use it to enhance student learning.
- Collaboration and Professionalism: The programme fosters collaboration and professional development opportunities to help teachers succeed in their careers.
- Providing strategies to help students become more self-aware of their beliefs and assumptions about learning and help them develop a growth mindset towards their own education such Self-assessment and Group work.

- Faculty Expertise: The programme employs highly qualified and experienced faculty who bring a wealth of knowledge and expertise to the program.

Considering these factors when evaluating teacher preparation programs is important because they can influence a teacher's effectiveness in the classroom and their ability to meet the diverse needs of students. It is crucial that education stakeholders assess these areas to make sure that teacher preparation programs provide the necessary knowledge, skills and experiences to prepared effectively linking the theory to practice.

2.4 Lessons from COVID-19 for Pre-Service Teachers

The critical phase during which the gap in theoretical knowledge and practical skills can be bridged experienced numerous disruptions, mainly due to shifting away from face-to-face interaction. One notable challenge associated with the inability to have traditional, in-person teaching experiences during internships for pre-service teachers was how it affected immersive learning, through which pre-service teachers could develop relevant competencies to applying theory to practice towards pedagogy and technology (Gorgoretti & Pilli, 2012).

As a result, pre-service teachers who were formerly involved in practice teaching experiences within schools, could not go through internships as usual. This change in the established norm posed a challenge for those responsible for teacher preparation programs in the Kingdom of Saudi Arabia, especially affecting that stage pivotal to its completion, namely the teaching internship. This phase, which played a significant role in establishing the transition between theoretical knowledge and development of practical skills, also underwent certain difficulties due to restrictions on personal educational activities.

Furthermore, mentors and supervisors faced limitations in monitoring and evaluating their students in person. In response to these challenges, institutions turned to electronic evaluation using Blackboard in online learning at Saudi universities using blackboard methods as a viable alternative. Pre-service teachers had to adapt to this new reality by using innovative means to showcase their teaching competencies.

In this context, pre-service teachers recorded themselves while conducting microteaching lessons from home, during synchronous virtual classroom sessions and

shared e-portfolios containing their daily lesson plans, while they undertook classroom teaching in schools. These measures enabled them to demonstrate their theoretical and practical teaching skills in a digital format. The impact of this transition from traditional internships to online alternatives during the pandemic was the subject of numerous studies (Alqurshi, 2020; Al-Samiri, 2021; Alshaikh et al., 2021; Alsuhaibani, 2021; Kristiyani, 2020). Some of the prominent challenges included aspects related to inquiring, strengthening classroom overall effectiveness as well while operating remotely. Even though these challenges existed, Kristiyani (2020) stressed the importance of technology and feedback information from lecturers and peers in promoting teaching internships that would prepare pre-service teachers for blended learning approaches. This view was corroborated by Samu (2020), who pointed out that the deficiency in real-life teaching practices within authentic classroom contexts could see graduate teachers unprepared for the practicality of their actual classrooms.

In a closely related study, Diamah et al. (2022) investigated the effect of a 14-day TPACK-based training programme on PSTs' perceived TPACK ability. The results highlighted in particular the importance of knowledge about technology to provide specific learning experiences, with the need for a strong evidence base and for constant training in new technologies. (TPACK will be discussed in detail in Chapter 3.)

Furthermore, Ping et al. (2020) found that teachers were willing to innovate in online teaching during the pandemic, adopting technologies, such as livestreamed classes and using recorded course videos arranged via instant messaging apps and online conference systems, for discussion purposes. This newly acquired experience enabled teachers to make use of available technology capabilities and to refine their online teaching practice.

At the same time, Theelen et al. (2020) conducted virtual internship experiments using video fragments that featured observing teachers teaching in real classrooms preparing for demanding situations, such as disruptions and introduction to lessons. The implications indicated that the virtual internships could serve as an ideal way of reducing high levels of anxiety among pre-service teachers as long they got acquainted with teaching context despite their lack or real life, face-to-face internship. Although some pre-service teachers did not see virtual internships as effective

(Jwaifell et al., 2018; Malik et al., 2019), research determined that these systems could act as innovative additions to the existing traditional preparation programs of pre-service teacher serving their purpose alongside real practices, while also addressing challenges specifically related to Covid-19 in this instance.

2.5 Barriers to Technology Integration

Two primary barriers hinder the integration of technology in education: first-order barriers, which are extrinsic and encompass factors such as limited access to digital tools and inadequate support; and second-order barriers, which are intrinsic and involve pedagogical beliefs and disposition towards technology (Ertmer, 1999). Several factors contribute to the current situation in which ICT has not been successfully implemented in the Saudi education sector. These include a lack of space allocation (for example, computer laboratories), inadequate Internet connectivity, limited resources, poor equipment maintenance, weak implementation of policies and strategies, a lack of IT skills among teaching faculty at schools and universities and insufficient professional development training for teachers (AlAmri & Saleh, 2019; Alghamdi & Holland, 2020; Alkinani, 2021; Alammary et al., 2022).

These challenges not only hinder the implementation of ICT in the education system but also result in a lack of knowledge and self-efficacy among Saudi pre-service teachers in using ICT, subsequently impacting future learners' ICT skills and broader digital competencies negatively.

Pre-service teachers should recognize the importance of adapting pedagogical approaches based on the specific content being taught, understanding that effectiveness may vary in different contexts.

A teacher education programme that prepares pre-service teachers to use ICT in their classrooms is the most effective way to prepare them with the necessary skills and knowledge to effectively integrate technology into their teaching practices. It is important for ITE programs to include mastery experiences with ICT to prepare PSTs to gain confidence to effectively integrate technology in their teaching (Gudmundsdottir & Hatlevik, 2018). The two main strategies in this process are to ensure that pre-service teachers are proficient in the use of technology and that they understand how to integrate technology into their teaching in meaningful and

effective ways (Starkey, 2020). This includes training in the use of specific technologies, as well as opportunities to experiment with and reflect on their use in the classroom (Cabero, 2014; Casillas et al., 2020; Witterholt et al., 2016).

To address the need for change and adaptation to modern educational paradigms, pre-service teachers in this study were introduced a framework provided a structured approach for teachers to consider the complex relationships between content, pedagogy and technology integration. These frameworks are discussed in Chapters 2 and 3.

2.6 Summary of Saudi Arabian Context

According to Nguyen and Bower (2018). the context within which a pre-service teacher uses technology significantly influenced teaching methods, content delivery and interactions with learners. This context formed a strong foundation for understanding pre-service teacher perceptions in higher education institutions regarding the integration of information and communication technology into the educational process.

Saudi Arabia has made substantial investments in teacher training programs to equip educators with digital competencies, aligning with the Vision 2030 plan (Kingdom of Saudi Arabia, 2022) to promote a knowledge-based economy (Engeness, 2021; González-Pérez & Ramírez-Montoya, 2022). However, despite the national goals outlined in Saudi Vision 2030 (Kingdom of Saudi Arabia (2022) to enhance the teaching profession and modernize educational institutions, research suggests that both in-service and pre-service teachers in training have not been effectively empowered to use ICT in education or integrate it into classrooms (Alghamdi, 2017; Alqahtani, 2019; Al-Seghayer, 2022).

In higher education, Saudi Arabia demonstrated remarkable progress in technology-focused programs, exemplified by its extensive network of technical colleges and universities. These institutions play a pivotal role in equipping students with the knowledge and practical skills necessary for success in fields such as computer science, engineering and information technology (Ismaeel & Al Mulhim, 2022).

Additionally, the Saudi Arabian government actively cultivated strategic partnerships with leading technology companies, underscoring its commitment to technological

education. These collaborations provide students with access to cutting-edge technology, positioning them at the forefront of innovation and well-prepared to meet the evolving demands of the tech industry (Oxford Business Group, 2022).

As part of its commitment to building a competitive, knowledge-driven society, Saudi Arabia recognized the importance of pre-service education in technology. However, despite these advancements, Saudi Arabia's higher education system faces persistent challenges in effectively integrating technology into teaching and learning (Ministry of Education, 2020). Issues such as the lack of training resources, outdated infrastructure and resistance to change pose obstacles for educators attempting to fully leverage technology (Almaiah et al., 2020; Alammary et al., 2022). It is crucial for Saudi Arabia's education system to address these challenges and ensure not only the accessibility but also the effective use of technology (Almaiah & Al Mulhem, 2019).

The challenging circumstances imposed by COVID-19 restrictions from 2020 to 2022 impacted efforts to provide quality education in Saudi Arabia, as reported by the United Nations (United Nations, 2020). The COVID-19 pandemic introduced a new landscape for ICT use in education (Chick et al., 2020).

2.7 Chapter Summary

This chapter provided a comprehensive exploration of the context of pre-service teachers' education in Saudi Arabia. The primary objective of this chapter was to present a detailed overview of the Saudi E-learning environment pre-service teacher education.

The chapter encompassed the historical and policy perspectives surrounding pre-service teacher education in Saudi Arabia, discussing the integration of technology in teacher education planning and instruction and the online platforms used for teacher training. Furthermore, the chapter delved into the historical evolution and contemporary practices of technology as it pertains to pre-service teachers.

Overall, this chapter serves as a foundational resource for understanding the intricate landscape of pre-service teacher education in the context of Saudi Arabia.

3. Literature Review

This chapter contains the following sections:

- Introduction
- Teacher Self-efficacy
- Self-efficacy and ICT
- Theoretical Background for this Research
- Assessing Self-efficacy
- Chapter Summary

3.1 Introduction

An overview of the relevant literature is presented in this chapter.

The first section explores in particular Teacher Self-efficacy in the use of technology, Field Experience and Support in Initial teacher education. Concerns and barriers can impede ICT integration in teaching, as discussed in the following section detailed in this chapter.

The Technological Pedagogical Content Knowledge (TPACK) framework and Substitution Augmentation Modification Redefinition (SAMR) model are introduced, identifying how they can be used to measure pre-service teachers' capability to effectively integrate technology into their teaching practice. By using the TPACK framework and the SAMR Model together, pre-service teachers' technology integration can be evaluated in terms of both their understanding of how technology can be used to support teaching and their ability to effectively integrate technology into their teaching practices.

The chapter concludes with a review of related literature and documentation that provides background information for the Saudi case studies of using technology in teacher education.

3.2 Teacher Self-efficacy

The term self-efficacy refers to an individual's judgment of their ability to achieve a certain level of performance (Bandura, 1997). It is the confidence a person has in their capabilities to coordinate and execute the cognitive, behavioural and social skills required to successfully complete a task (Bandura, 1997). Furthermore, their beliefs about their ability to organise practical actions are necessary to manage future situations and overcome difficult problems (Bandura, 1995). These self-efficacy beliefs are important because they influence how teachers manage their educational responsibilities and duties and how these duties affect their students and classroom activities (Prat-Sala & Redford, 2010; Van Dinther, Dochy, & Segers, 2011).

Bandura (2002) assumed that the strength, level and development of self-efficacy in an individual evolves through four sources. The first is related to mastery experiences because these have an impact on an individual's self-efficacy. Through practice and successful experiences in developing skills, our self-efficacy increases. A second source of self-efficacy is from observing others successfully completing tasks. Such possibilities include the assumption that when the assumed connection between the observer and the model is greater, one gains the ability to master comparable activities. Social or verbal persuasion can also strengthen an individual's belief in being able to achieve. When an individual is told they have what it takes to succeed, they are more likely to succeed as their sense of belief in their abilities increases.

Finally, an individual's physiological and affective responses can have a positive impact on their self-efficacy. Moderate levels of arousal when challenged are perceived to focus attention and energy on the task at hand, whereas too much arousal can distract and interrupt the application of capabilities and skills, all having an impact on a person's sense of self-efficacy (Tschannen-Moran & McMaster, 2009).

Before involvement in the education process in this study, pre-service teachers possessed a level of self-efficacy about their skills and desire to teach. Pre-service teachers acquired educational knowledge during studies at university and observed of their own teachers (at various educational levels) and formed judgements from these observations. Their professors also had influence, about class management, communication with students and the adequacy of teaching. These factors not only

impacted student knowledge but also student self-efficacy, which in turn has an impact on personal competence and ability.

As the educational process has become increasingly complex, effective teaching requires more than just possessing knowledge. It demands various competencies from teachers, among which self-efficacy is crucial (Zee et al., 2018). Self-efficacy involves not only the belief in one's ability to accomplish tasks but also the belief that these efforts will yield desired outcomes. Bandura (1986) believed that individuals have a system of self-beliefs that enable them to control feelings and thoughts. Accordingly, the way an individual thinks, believes and feels affects the behaviour of that individual. The individual "works to explain his achievements based on the abilities that he believes he possesses" (Bouqfa, 2013, p. 6).

Self-efficacy among teachers is shaped by situational factors, including teaching experience, pedagogical knowledge, attitudes, and personality traits (Bandura, 1986). The development and maintenance of teacher self-efficacy is therefore essential to ensuring the future success of pre-service teachers.

Teachers with high self-efficacy performed better in the classroom and were less likely to leave the profession (Black, 2015; Klassen et al., 2013; Patterson & Farmer, 2018).The pre-service teachers' self-efficacy is likely to dwindle when they face the reality of their learning gaps particularly during the introductory classes and the initial teaching training (Moseley, Reinke, & Bookout, 2003; Hoy & Woolfolk, 1990; Wenner, 2001). Self-efficacy, as proposed by Bandura (1986), refers to individuals' beliefs in their ability to achieve desired outcomes. It is influenced by mastery experiences, vicarious experiences, social persuasion, and physiological/affective states. Initially, individuals may doubt their capabilities, but as they gain mastery and enhance their competencies, their self-efficacy tends to increase (Bandura, 1986). This understanding forms the basis for discussing how self-efficacy evolves among educators. However, this tendency reverses as they gain mastery experience and enhance their knowledge and competencies, aligning with prior research findings.

Smetackova (2017) reported that teachers who lacked self-efficacy experienced difficulties managing difficult situations and promoting student learning outcomes. In order to develop self-efficacy in pre-service teachers, in turn promoting the success of their students, we must support their well-being and their self-efficacy.

In contrast, pre-service teachers who do not have high technological self-efficacy are likely to be hindered in their ability to influence others (Al-Watban, 2011). They may also seek to try to cover up their inability, by following methods and methodologies that tend to control and oppress. Results in -AlWatban (2011) indicated that teachers with low self-efficacy set weak goals so as not to show their inability in front of others because they hold negative beliefs about themselves and their abilities and thus, they resisted everything that was new or changed. Accordingly, level of efficacy beliefs can play a role in teacher success.

The personality possessed by the professor played an important role in performance as an academic. Hashweh (2005) pointed out the importance of the teacher's beliefs and his role in how he teaches his specialty, considering the pedagogical structure to be an interaction between the teacher's knowledge of the educational content on the one hand and his beliefs on the other hand (Ruwaidi, 2008).

Given the importance of self-efficacy and how closely it is linked to behaviour of pre-service teachers, it is important to enrich the Saudi teacher education with tools that are able to measure self-efficacy through construction or codification. These tools considered a national task entrusted to specialists in the field of measurement and evaluation. A scale that measures beliefs that pre-service teachers hold about their self-efficacy was therefore considered of high importance.

3.3 Self-efficacy and ICT

This section explores self-efficacy and how it relates to pre-service teachers, particularly in the use of Information and Communication Technology (ICT).

This section consists of the following sub-sections:

- Self-efficacy using ICT.
- Self-efficacy, Educational Technology and Learning Outcomes.
- Benefits of Enhancing ICT Self-efficacy.
- Self-efficacy of Saudi Pre-Service Teachers.

3.3.1 Self-efficacy using ICT

Self-efficacy in using ICT refers to an individual's belief in their capability to effectively use technology tools and applications. This belief significantly influences

their motivation, confidence, and decision-making in technology-related tasks. High self-efficacy in ICT can lead to improved job performance and enhanced problem-solving skills (Ertmer & Ottenbreit-Leftwich, 2010).

The literature on educational theory and methods is extensive, encompassing various aspects of teaching and learning. Similarly, the use of technology in education and its impact on classroom practices has been widely studied. However, research specifically exploring the relationship between teacher self-efficacy and ICT use is less abundant. Even more limited is the research focused on these dynamics within the context of Saudi Arabia, particularly during the COVID-19 pandemic (Giles & Kent, 2016; Robertson & Al-Zahrani, 2012; Saienko, Lavrysh, & Lukianenko, 2020).

Given the significance of these relationships for this study, the literature review first addresses self-efficacy as a concept, with an emphasis on Bandura's seminal work (1995, 1997, 2002). It then explores the associations between teacher self-efficacy, competence in ICT use, and the effectiveness of technology application within Saudi Arabia's education system. This review sets the foundation for understanding how self-efficacy in technology impacts teaching practices and student outcomes in the context of this study.

3.3.2 Self-efficacy, Educational Technology and Learning Outcomes

The relationship between the use of educational technology, self-efficacy and the learning outcomes of PSTs is not often discussed in the literature (Menekse, Anwar, & Purzer, 2018). This is because the educational process has been subjected to various transformations in recent years, such as the transition towards using e-learning strategies and transformations in education systems. Transitions are usually accompanied by a lack of clarity of the teachers' vision, especially PSTs, because they often lack the confidence to adapt the curriculum according to student needs (Jimenez-Silva, Olson, & Jimenez Hernandez, 2012).

Han, Shin and Ko (2017) examined how teaching experiences affect pre-service teachers' self-efficacy in their teaching practice. The study included 55 pre-service teachers in a student teaching practicum and examined the effect of technology-centred student teaching experiences on their self-efficacy and intention to use technology, based on their teaching beliefs. The motivation for PSTs comes from their

previous teaching experiences which formed pedagogical beliefs in their cognition. They found that technology-centred teaching experiences enhanced the self-efficacy of PSTs regardless of their beliefs about teaching and significantly increased their intention to use technology in their teaching practice. The results of this study indicated that mastery experiences are an important component of PST self-efficacy, motivating them to conduct educational activities that incorporate the effective use of technology. Mastery experiences also helped individuals to face the challenges of improving their performance and development skills.

Al-Awidi and Alghazo (2012) examined 73 pre-service primary teachers' self-efficacy beliefs and confidence to integrate technology into their field placement experience while enrolled in the United Arab Emirates. The survey was followed by structured interviews to explore the four sources of self-efficacy beliefs. The results indicated a significant positive impact on pre-service primary teachers' self-efficacy around technology integration after completing the field placement experience. The most influential sources of self-efficacy for technology integration were mastery experiences and indirect experiences arising from the supervising teachers' comments. Thus, PSTs work with their supervising teacher obtain specific feedback which contributes to PSTs further developing their skills.

Berg and Smith (2018) conducted a study to examine the impact of the final field placement experience on the teacher self-efficacy beliefs of 75 preservice teachers in an ITE programme in New Zealand. The study also compared the effectiveness of two established measures of teacher self-efficacy. The results showed that the participants' self-efficacy beliefs increased after the practicum and both measures were found to be useful. The study suggests that capstone practicum experiences can improve preservice teachers' self-efficacy beliefs. This outcome aligns with Bandura (1997) and more recent authors (for example, Thornton et al., 2020; Van Rooij et al., 2019) who have argued that once mastery experiences are achieved, they are more likely to become cognitively embedded and lead to high levels of teacher self-efficacy, student achievement and positive school improvement.

More recently, Jin and Harp (2020) conducted a limited study in which they examined the attitudes, self-efficacy and the technological, pedagogical and content knowledge (TPACK) of 32 PSTs before and after taking an educational technology course incorporating Flipped Classroom design (FC) and Team Based Learning (TBL). They

found that the PSTs had higher post-self-efficacy scores and TPACK development after completing the course. This study recommended that researchers should apply a different pedagogical strategy for mastery experiences and collect more data sources to enable triangulation of data to develop a greater understanding of how PSTs develop their TPACK.

Masri's (2020) study, aimed to determine the impact of field training in improving the perceived self-efficacy and counselling skills of postgraduate students in the psychological and educational guidance programme at a university in Palestine. The sample consisted of (44) male and female students. They were selected using a simple random sample method from the study population of students who received field training. The results indicated that there is a role for field training in improving perceived self-efficacy and it came to a high degree. There are statistically significant differences in the averages of perceived self-efficacy according to the gender variable in favour of males.

Abdo's study (2021) also aimed to identify the level of self-efficacy among science teachers before and during service and used constructivist strategies to teach science. A measure of self-efficacy for teaching science among student science teachers and science teachers in Alexandria Governorate was prepared and the measure was applied to a sample of student teachers. It consists of (328) male and female students from the fourth year, science section and consists of (67) male and female science teachers in general education. The research concluded that there is a statistically significant difference between the average scores of student teachers in the scale as a whole and the nominal average of the scale determined by the research. Also, there are no statistically significant differences between the average scores of student teachers on the self-efficacy scale, due to gender and specialization.

Robertson and Al-Zahrani (2012) conducted a mixed-methods study in the Saudi context to verify the levels of self-efficacy of Saudi PSTs in using technology. This study found that increasing PSTs' preparation and exposure to ICT have helped to improve the computing habits, motivation and self-efficacy of PSTs. Even though the results of this study indicated that Saudi PSTs have a high level of general self-efficacy in the use of technology, they remain conservative in relation to their traditional methods regarding educational practices and the integration of technology. In response to such attitudes, competent modelling and professional development

models to create vicarious experiences have been developed using videos of skills or strategies in action.

When teaching, the practices of PSTs largely depend on the degree of self-efficacy developed during their training prior to their graduation (Özdilek & Bulunuz, 2009). This supports Bandura's (1997) view that self-efficacy is formed in teachers during the early stages of their teacher education and becomes permanent and resistant to change.

This is in line with recent study (Gonzalez & Ruiz, 2016; Zee et al., 2018) exposing pre-service teachers to examples of best practices in technology integration can inspire and motivate them to improve their own use of technology. Therefore, the evaluation of teacher preparation programs should include the degree to which the integration of technology is core to the teaching and assessment and should include measures of teacher self-efficacy.

Several researchers have considered the effects that professional development has on improving teachers' self-efficacy. According to Ross and Bruce (2007), more effective teaching should increase teachers' likelihood of obtaining mastery experiences, the most influential predictor of self-efficacy. Furthermore, Bruce, Esmonde, Ross, Dookie and Beatty (2010) found a consequential and indirect relationship between teacher self-efficacy and student achievement. They argued that the most supportive activities are the sharing of teachers' constructive teaching techniques and practices, the sharing of student work and context-embedded experiences are the most beneficial aspects that lead to increases in teachers' self-efficacy, which in turn improved student results. Similarly, Takahashi (2011) suggested that learning in a community of practice was directly related to teacher self-efficacy. Van den Bergh, Ros and Beijaard (2014) added that the learning should involve thinking, practice and active participation through applying ideas to teaching. Finally, Yoo (2016) investigated the effects of online professional development on teacher self-efficacy. Therefore, the findings of the research published in the academic literature have clearly shown that obtaining new knowledge is positively linked to teacher efficacy.

In summary, the literature connects the research on professional development and self-efficacy factors, such as mastery experiences, to increased teacher self-efficacy. Similarly, working within a community of practice and peer support has been

identified as essential for effective ICT use. Furthermore, other self-efficacy factors, such as verbal persuasion and emotions, should be considered during PST programs.

3.3.3 Benefits of Enhancing ICT Self-efficacy

The challenge of enhancing pre-service teacher (PST) education with a focus on the effective use of ICT is a complex issue that has garnered the attention of researchers and practitioners (Otero et al., 2005; Prat-Sala & Redford, 2010; Sutton, 2011). Recent research, such as the study conducted by Bozkurt et al. (2020), points out a notable deficiency in the engagement of PSTs with ICT in the teaching-learning process. Moreover, the global context has been reshaped by the impact of school closures during the COVID-19 pandemic, exposing social injustices and inequities. This necessitates a re-evaluation of current practices for emergency remote education, emphasizing a pedagogy of care and open access for all students in education.

Considering these challenges, it's crucial to recognize that, in the Kingdom of Saudi Arabia (KSA), the field of education and the values embedded within the education system have yet to fully adapt to or reflect meaningful engagement with ICT. This gap in initial teacher education programs can be attributed to the limited practical classroom experience with technology, despite the presence of some pre-service courses designed to teach teachers how to use ICT (Alharbi, 2019a).

To address the challenge of preparing pre-service teachers effectively, it's essential to consider alternative means, such as fostering a community of practice through which PSTs can connect with practicing teachers, as proposed by Bruce et al. (2010). Aligning with the objectives outlined in Saudi Vision 2030, which underscores the significance of ongoing training for in-service teachers and advocates for an ICT-inclusive pedagogy in pre-service teacher training, the goal is to meet the demands of 21st-century education. Therefore, a comprehensive approach is required for developing future teachers, one that considers the flow of skills and knowledge (Day, 2000).

Furthermore, it's valuable to draw inspiration from studies such as the one conducted by Kafyulilo and Fisser (2019), which sought to address low technology uptake by science and mathematics pre-service teachers. Their approach, which focused on creating a professional development arrangement emphasizing collaborative design of technology-enhanced lessons, led to notable improvements in teachers' technological

knowledge, technological pedagogical knowledge, technological content knowledge and TPACK. The study underscored the importance of professional development initiatives that target specific knowledge gaps and promote collaboration among teachers. This approach aligns with the need for a comprehensive transformation in pre-service teacher education to prepare educators for the ever-evolving landscape of education and technology.

Recent research conducted by Alshammari, Alharbi & Almutairi (2022) and Ngao, Sang & Kihwele (2022) highlights a significant deficiency in the engagement of pre-service teachers (PSTs) with information and communication technology (ICT) in the teaching and learning process. This research indicates that pre-service teachers in Saudi Arabia face challenges in acquiring the essential technical knowledge required for effective ICT utilization in the classroom. Key findings from these studies include:

Pre-service teachers often lack the technical knowledge necessary for proficient ICT use. Barriers to effective ICT utilization encompass a shortage of training opportunities and limited access to essential resources. Additionally, the investigation conducted by Ngao, Sang & Kihwele (2022) reveals that teacher educators encounter obstacles when striving to incorporate ICT into pre-service teacher education. These challenges encompass a lack of comprehensive understanding of ICT's pedagogical potential and limitations related to equipment. Some teacher educators' express reservations about the relevance of integrating technology in teaching, while equipment-related issues, heavy teaching workloads and time constraints hinder successful integration efforts.

3.3.4 Self-efficacy of Saudi Pre-Service Teachers

Self-efficacy has been shown to be a significant factor in understanding the level of success perceived by teachers in the use of technology in their lessons and the frequency of use in their work (Giles & Kent, 2016). Furthermore, teacher beliefs about their proficiency with technology are often closely related to their level of integration of technology in teaching. Despite efforts by institutions and teacher training programs to prepare pre-service teachers (PSTs) in the use of technology, the successful incorporation of technology into teaching practice has faced challenges in certain contexts, such as Saudi Arabia (Al-Kathiri, 2011; Karabuz & Ogan-Bekiro).

To address this gap, this research aims to explore not only whether PSTs developed self-efficacy for technology but also how this development occurred. Understanding the process of self-efficacy development is crucial in determining the level of ICT use PSTs are likely to employ in their teaching. Initial Teacher Education (ITE) programs have not prepared PSTs to integrate technology in their lessons to enhance their student's learning (Koh, Chai, & Lim, 2017; Niess, 2005; Resta, 2002). Consequently, PSTs completing their pre-service training in Saudi Arabia may not have the desired level of self-efficacy in application of ICT in classroom teaching, representing a serious problem towards the accomplishment of the Saudi Vision 2030 (Al-Helayyil, Rajan, Claps, & Schaller, 2016).

An important but under-investigated influence on the incorporation of technology in lessons by PSTs is how their perceived self-efficacy influences knowledge, use and integration of technology in their planning and teaching (Abu-Arrad & Fosaiel, 2006; Al-Abdullatif, 2019). Therefore, this research focuses on investigating the processes and factors influencing the development of self-efficacy for technology among pre-service teachers. By delving into the intricacies of their self-efficacy formation, including the role of educational experiences, mentorship and training programs, the study aims to provide a nuanced understanding of how pre-service teachers cultivate the confidence and skills necessary for effective technology integration in their future teaching practices. It is crucial to understand how the use of ICT will affect the level of ICT usage in the classroom of these pre-service teachers. (Peciuliauskiene et al., 2022; Pozas et al. 2022).

3.4 Theoretical Background for this Research

This section consists of the following sub-sections:

- Introduction
- Pedagogical and Content Knowledge Framework
- Extending the PCK Framework to TPACK
- Detail of TPACK Framework
- SAMR Model
- Combining TPACK and SAMR

- TPACK, SAMR and Self-efficacy

3.4.1 Introduction

Models of technology integration provide a valuable framework for researchers and practitioners seeking to comprehend the essential components necessary for the successful incorporation of technology into teaching and learning. Two such models, the Technological Pedagogical Content Knowledge (TPACK) and the Substitution Augmentation Modification Redefinition (SAMR) models, are instrumental in guiding the preparation of pre-service teachers in their use of technology for educational purposes. The purpose of this section is to provide a description of these two models followed by an examination of related studies.

It is not clear from the TPACK framework how to evaluate the extent to which technology is changing the learning experience, which indicates that the framework alone may not be sufficient for fully integrating technology into teaching practices. To assess student technology integration in the classroom and to guide Pre-service teachers specifically toward more transformative uses of technology, the SAMR model, which stands for Substitution, Augmentation, Modification and Redefinition can be used in conjunction with TPACK.

The TPACK model, as outlined by Porras-Hernández and Salinas-Amescua (2013), takes into account the significance of contextual factors, particularly focusing on two key dimensions: scope (macro, mezzo, micro) and actor (teacher/learner internal context). At the micro level, within the classroom, the model considers the specific conditions that influence technology integration. The mezzo level considers the local circumstances that impact technology usage, while the macro level encompasses the global conditions affecting technology integration.

Similarly, the SAMR model is a framework that classifies technology use into four levels: Substitution, Augmentation, Modification and Redefinition. This model encourages educators to progress from merely replacing traditional teaching methods with technology (Substitution) to enhancing learning experiences (Augmentation), redesigning tasks and activities (Modification) and ultimately redefining the learning process by leveraging technology in innovative ways. The SAMR model inspires pre-service teachers to move beyond surface-level technology integration toward transformative practices that enhance teaching and learning.

While these models provide valuable guidance for technology integration in teacher education, it's crucial to recognize that effective implementation depends on contextual factors and teacher readiness, echoing the importance of the interplay between the macro, mezzo and micro levels in the TPACK & SAMR model. In the following sections, we will delve deeper into the practical application of these models in preparing pre-service teachers to effectively leverage technology for enhanced educational outcomes.

3.4.2 Pedagogical and Content Knowledge Framework

A pedagogical and content knowledge (PCK) framework was developed by Shulman (1986). This framework helped to explain how teachers' knowledge of educational technologies and Pedagogical Content Knowledge (PCK), as extended by Mishra & Koehler's Technological Pedagogical Content Knowledge (TPACK) framework, interact to achieve effective teaching through technology.

Content Knowledge (CK) is the content or subject and includes what PSTs know about specific subjects, such as mathematics, sciences, or history. For example, CK encompasses a PST's knowledge of the concepts, theories, models and conceptual frameworks about a particular subject, in addition to the practices and techniques used to facilitate such knowledge (Koehler & Mishra, 2009).

Pedagogical Knowledge (PK)

Pedagogical Knowledge (PK) is the teacher's understanding of the teaching and learning activities or processes, while considering individual differences between learners. The teacher's PK influences how students learn in general and is not restricted to specific content knowledge. Across all subject areas, the teacher's interpretation of cognitive, social and developmental theories is applied and student comprehension of what is taught is continuously evaluated (Koehler & Mishra, 2009) to inform teachers' actions.

Pedagogical Content Knowledge (PCK)

According to Shulman (1986), PCK is the knowledge of methods for integrating content and teaching methods to achieve best practice in the educational process. Shulman's theory offers a conceptual framework for teachers to think about various ways of approaching subject matter and how they would teach it or provide appropriate learning experiences, such as explanations and comparisons, carefully

chosen by the teacher and presented to students to make the topic relatable and understandable to them.

3.4.3 Extending the PCK Framework to TPACK

The Technological Pedagogical and Content Knowledge (TPACK) framework developed by Mishra and Koehler (2006) evolved from the pedagogical and content knowledge (PCK) model developed by Shulman (1986) (see Section 3.4.2). The TPACK framework is a contemporary model that emphasises the integration of t echnology and content knowledge with knowledge of pedagogy, which have emerged as key requirements for effective teaching (see Figure 3-1).

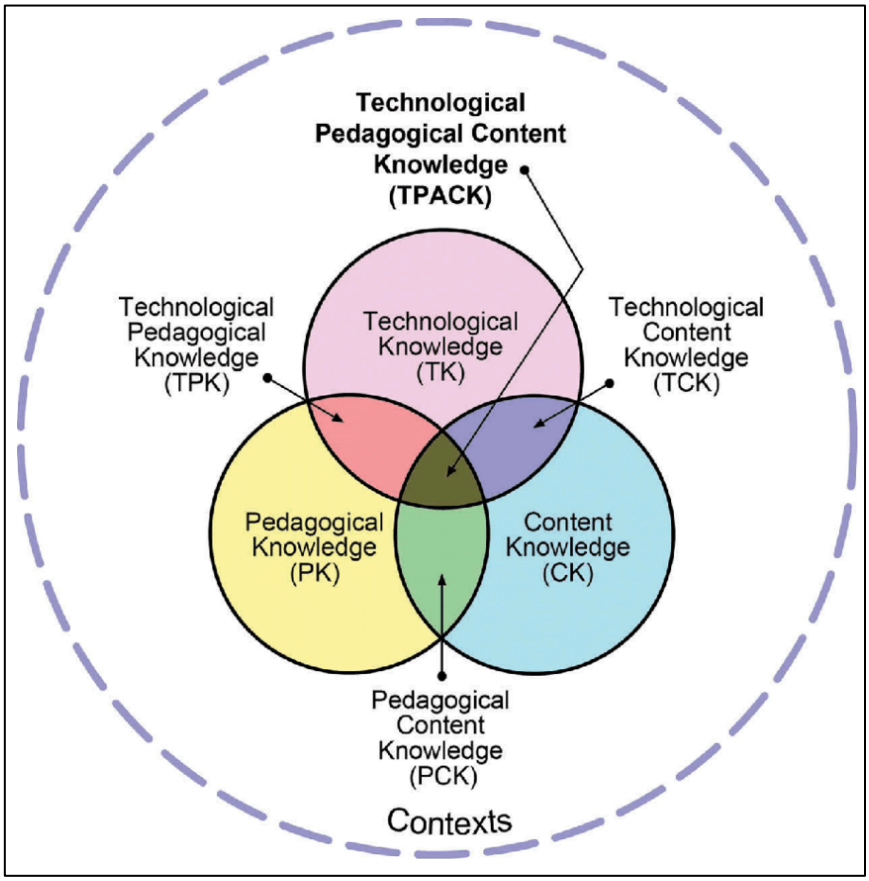

Figure 3-1. TPACK framework (Koehler & Mishra, 2008, p. 3).

Technology Knowledge (TK)

TK includes general knowledge and skills that teachers must understand sufficiently to apply them effectively in the classroom (Koehler & Mishra, 2009). TK also enables teachers to modify techniques so that they can be used to enhance learning. This knowledge involves familiarity with various technologies that a teacher might use in the classroom, such as mobile phones, multimedia so on.

Technological Content Knowledge (TCK)

There are multiple ways in which teachers implement technologies to enhance teaching and learning. One example of this is the decisions teachers make about which tools to incorporate into their teaching of mathematics. The use of dynamic spreadsheets as a tool for exploring and learning mathematics would be an example of a teacher implementing technologies to enhance the teaching and learning of mathematics. Which is a thorough understanding of the way in which the implementation of specific technology will alter the subject matter (Koehler & Mishra, 2009).

Technological Pedagogical Knowledge (TPK)

TPK is knowledge of the existence, components and capabilities of various technologies applicable to different teaching settings, or conversely, knowing how teaching might change as a result of using particular digital tools. TPK can involve knowledge of presenting subject content using multimedia tools for learning and helping students use technology to search for content-related sources of information (Koehler & Mishra, 2009).

3.4.4 Detail of TPACK Framework

The Technology, Pedagogy and Content Knowledge (TPACK) framework focuses on how to employ technology to match the teaching method needed to teach specific content within a specific educational context, reflecting the interaction and amalgamation of the three main knowledge dimensions of the framework. All three of these separate constructs of knowledge overlap at the critical juncture, or "sweet spot," of TPACK. The TPACK model highlights that there is no single digital solution that can be extended to any academic personnel, any subject matter, or any other solution for teaching and learning (Koehler & Mishra, 2009). The elegance of the TPACK framework reveals a theoretical framework in which technology expert knowledge, subject expert knowledge and pedagogical expert knowledge combine to achieve effective technology integration.

Various scholars have illuminated diverse aspects of Technological Pedagogical Content Knowledge (TPACK), revealing its multidimensional application in different educational contexts. Valtonen et al. (2018) explored differences in awareness and

preparedness to integrate ICT in education. Schmid et al. (2021) investigated STEM, social sciences and language pre-service teachers' self-reported TPACK, discovering no significant differences in TPACK components based on technology use intentions or target audience (teachers or students). Subject-specific variations emerged, with STEM pre-service teachers exhibiting higher Technological Knowledge (TK) and Technological Content Knowledge (TCK) and overall high TPACK correlating with increased technology integration in lesson plans, a correlation absent in language and social science pre-service teachers.

Von et al. (2022) explored the impact of TPACK beliefs in Pre-service Biology teachers on lesson plans, finding self-reported TPACK not predicting technology integration quality, while performance assessed TPACK and beliefs about learning with digital technologies emerged as significant predictors. Characteristics of high-quality lesson plans included interactive and collaborative student activities, student reflection and creativity, contrasting with low-quality plans characterized by passive activities and a lack of real-world connection. This underscores the importance of performance assessed TPACK and beliefs in predicting technology integration quality.

Zimmermann et al. (2021) delved on Pre-service Chemistry teachers, examining TPACK self-efficacy, attitude and lesson planning competency. Their study demonstrated a positive impact of a teaching methods and educational technology seminar on participants' skills, TPACK self-efficacy and attitudes toward educational technology. The participants' changes in TPACK self-efficacy and attitude emphasized the significance of engaging and practical training in enhancing educators' technology integration capabilities.

In the study conducted by Kartal et al. in 2021, the focus was on the development of Technological Pedagogical Content Knowledge (TPACK) among preservice science teachers during a technology-enhanced science teaching methodology course. The findings indicated a positive impact of the course, which incorporated technology-supported learning and teaching experiences. The experimental group, exposed to the technology-enhanced curriculum, exhibited significant improvements in Pedagogical Knowledge (PK), Content Knowledge (CK), Technological Pedagogical Knowledge (TPK) and overall TPACK. The most substantial enhancement was observed in the central TPACK component. Conversely, the control group, without the technology-

enhanced course, did not demonstrate significant improvements in their TPACK. Overall, the study suggested that integrating technology-supported experiences into teacher education programs could effectively enhance preservice teachers' TPACK.

In the research by Rodríguez-Becerra et al. (2020) on Chemistry, the focus was on the emergence of TPACK through an educational Computational Chemistry perspective. Data collection involved surveys and interviews with preservice chemistry teachers, both before and after the semester. The results, obtained through a mixed between-within subjects' analysis of variance, revealed partial improvements in the preservice teachers' TPACK components. Gender was not found to be a significant factor in technology integration. The study emphasized the need for more context-specific technology applications in the learning and teaching environment to further develop the TPACK framework.

Große-Heilmann et al. (2022) concentrated on physics to enhance pre-service physics teachers' pedagogical content knowledge about digital media. The study, conducted across three German universities, incorporated a seminar with common core elements tailored to individual curricular requirements. The evaluation demonstrated a significant increase in students' digital-media PCK, particularly for those participating in both theoretical and practical sessions of the seminar. The study highlighted the importance of targeted interventions to enhance pre-service teachers' knowledge of digital media in the context of physics education.

Gonzalez & Ruiz (2016) explored the misalignment between pre-service teachers' intentions to use technology in math teaching and their TPACK. The study, conducted with Spain pre-service teachers, revealed a significant gap between their behavioural intentions and actual TPACK. The findings underscored the necessity of emphasizing TPACK in pre-service teacher education programs to effectively integrate technology into mathematics teaching.

Akyuz (2023) delved into contextual elements influencing pre-service teachers' implementation of TPACK when teaching with technology. The impact of context was highlighted in a case study involving four pre-service teachers on TPACK demonstration during planning and teaching stages. Findings indicated that those with lower TPACK were more concerned with practical issues, while those with higher levels prioritized beliefs and external factors. The study emphasized the importance of

considering contextual factors in understanding and improving TPACK implementation.

According to Saudi context, three studies implemented TPACK use for pre-service teachers. In the first study, technological knowledge (TK) and technological pedagogical and content knowledge (TPACK) confidence among Saudi pre-service teachers were investigated (Al-Abdullatif, 2019). The findings revealed low competence in digital technologies, with gender differences in confidence. A significant percentage of Saudi pre-service teachers demonstrated a low level of perceived competence in using digital technologies for teaching and learning, with female participants exhibiting higher confidence and readiness for information and communication technology practices.

The second study compared the impact of electronic and traditional teaching internship strategies on TPACK skills among Saudi pre-service teachers (Ismaeel & Al Mulhim, 2022). The study highlighted significant differences between groups and advocated for a blended approach in teacher preparation programs. Notable variations were observed between pre-service teachers in traditional and electronic teaching internship groups, particularly in technological knowledge (TK), pedagogical knowledge (PK), pedagogical content knowledge (PCK), technological content knowledge (TCK), technological pedagogical knowledge (TPK) and TPACK. The study recommended adopting a blended teaching approach.

In the third study, the impact of teacher education training programs on TPACK among Saudi pre-service teachers was assessed (Alshawaf, 2020). The study reported a significant increase in perceived knowledge, gender differences and the influence of computer usage skills on knowledge gain. Notably, there was a substantial rise in perceived TPACK knowledge among Saudi pre-service teachers by the end of the training program. Gender differences favoured males in various TPACK components and higher computer usage skills correlated with less knowledge gain, particularly in technological knowledge (TK) and TPACK.

Finally, Tseng et al. (2019) examined how TPACK was implemented among pre-service English teachers during web-conferencing learning within the framework of computational education. The review of TPACK research specific to language teachers from 2011 to 2019 revealed varying confidence levels among teachers, a

preference for technology in traditional teaching and challenges in contextualizing survey items for assessing TPACK. Effective interventions in developing TPACK included understanding the framework, modelling and collaborative lesson design. The study called for further research to assess TPACK in practical contexts.

In the conclusion, the reviewed studies highlight the significance of integrating technology into preservice teacher education programs to promote TPACK. Positive effects of technology-supported learning scenarios were noted in all subject areas, including science, chemistry physics and mathematics English. These results emphasize the importance of considering contextual factors that include beliefs, external influences and practical considerations in understanding TPACK comprehensively.

Moreover, three studies on TPACK of pre-service teachers in Saudi Arabia were found during literature review. While these studies provide valuable insights into technology application, they do not consider the SAMR model, limiting their overall comprehensiveness. It is evident that there exists a significant research gap in the preparation of graduates on student teaching programs in terms of knowledge and skills to effectively incorporate technology into their pedagogical practices. The studies emphasize the need for purposeful intervention, collaborative planning of lessons and a complex understanding of the TPACK model to improve both preservice teachers' effectiveness and their confidence in using technology. The research also highlights the fact that TPACK is a concept which must be further explored and evaluated in authentic teaching situations, providing useful recommendations for teacher education programs. The review will explore the SAMR model and its significance in studying technology use, along with relevant studies that establish a more comprehensive view.

The intersection of the Technological Pedagogical Content Knowledge (TPACK) and also the Substitution Augmentation Modification Redefinition model (SAMR), featured in relation to pre-service teachers' self-efficacy, provides a complex landscape. Even though there are many common challenges shared by the pre-service teachers across the globe, some specific complications can be observed related to their level of tech proficiency.

A literature review found studies that deal with Saudi pre-service teachers' Technological Pedagogical Content Knowledge (TPACK). The existing investigations primarily centre on exploring perceptions and practices related to technology integration in the classroom setting. Importantly, it is recognized that there is a notable gap in research concerning whether graduates from student teaching programs in the Kingdom of Saudi Arabia (KSA) possess sufficient preparation in terms of knowledge and skills to adeptly integrate technology into their teaching methodologies.

The study by Al-Abdullatif (2019) examined the TPACK of Saudi pre-service teacher confidence, revealing a notable lack of perceived competence in using digital technologies for teaching and learning, with female participants exhibiting greater readiness for information and communication technology practices. Similarly, the study by Ismaeel and Al Mulhim (2022) share a common focus on evaluating and enhancing the technological competencies and pedagogical knowledge of pre-service teachers in the context of Saudi Arabia, which compared the impact of traditional face-to-face and electronic teaching internship strategies on pre-service teachers' TPACK skills, finding significant differences between groups and emphasizing the importance of blending teaching methods. Furthermore, the study by Alshawaf (2020) assessed the preparation of pre-service teachers in Saudi Arabia for technology integration, showing a significant increase in perceived TPACK knowledge by the end of the training programme and revealing gender differences and the impact of computer usage skills on knowledge gain, providing insights for enhancing teacher training programs in the Kingdom. Conclusively, Saltan and Arslan (2017) compared the self-confidence of 388 pre-service and 211 in-service teachers in technological pedagogical content knowledge (TPACK). Results indicated both groups showed highest confidence in technological content knowledge. Pre-service teachers had lower TPACK scores, particularly in technological knowledge, while in-service teachers scored lowest in this domain. Additionally, pre-service mathematics teachers had lower TPACK than science teachers and in-service ICT teachers demonstrated higher TPACK compared to science, mathematics and classroom teachers in TPACK, pedagogical content knowledge (PCK) and technology knowledge (TK) domains. Similarly, Bingimlas (2018) examined Saudi teachers' knowledge of technology related to the three essential components of TPACK: TK, CK and PK the authors

found their knowledge of technology, content and pedagogy lacking. Bingimlas ascribed this result to lack of modern technology training and unwillingness to change the conventional teaching methods. This is because the pre-service teachers favour tasks that they feel confident in carrying out and shed those activities where they lack confidence (Choi & Lee 2017).

Therefore, the Saudi studies on TPACK collectively reveal notable challenges and opportunities in the preparation of pre-service teachers. Al-Abdullatif's (2019) investigation highlights a prevalent low competence among pre-service teachers in integrating digital technologies for teaching. Ismaeel & Al Mulhim's (2022) study underscores the significance of blending traditional and electronic teaching internship strategies for enhancing TPACK skills. Alshawaf's (2020) findings indicate an increase in perceived TPACK knowledge among pre-service teachers, with gender differences and the influence of computer usage skills on knowledge gain. Lastly, Saltan & Arslan's (2017) exploration of self-confidence in TPACK emphasizes variations between in-service and pre-service teachers, particularly in the technological content knowledge domain, calling attention to the need for focused interventions in Saudi teacher education programs to fill the gap between knowledge and practice.

To bridge the insights from the Saudi studies on TPACK and the SAMR model, it is crucial to establish a connection between the challenges identified in pre-service teacher preparation and the potential solutions offered by the SAMR framework. The studies highlight varying levels of competence and the need for a blend of teaching strategies to enhance TPACK skills. Considering these challenges, the SAMR model provides a valuable framework for guiding the integration of technology in teaching to ensure consistent and effective technology integration throughout a teacher's career.

To sum up, Saudi studies shed light on challenges and opportunities in pre-service teacher education and the SAMR model provides a roadmap for progressively integrating technology into teaching practices by providing a structured approach. After that, the review of SAMR model and its value in researching technology implementation into education will be considered below supported with relevant studies for holistic analysis.

3.4.5 SAMR Model

The Substitution Augmentation Modification Redefinition (SAMR) model (Puentedura, 2020) represented four levels of technology integration into education: substitution, augmentation, modification and redefinition.

The SAMR model is depicted in Figure 3-2.

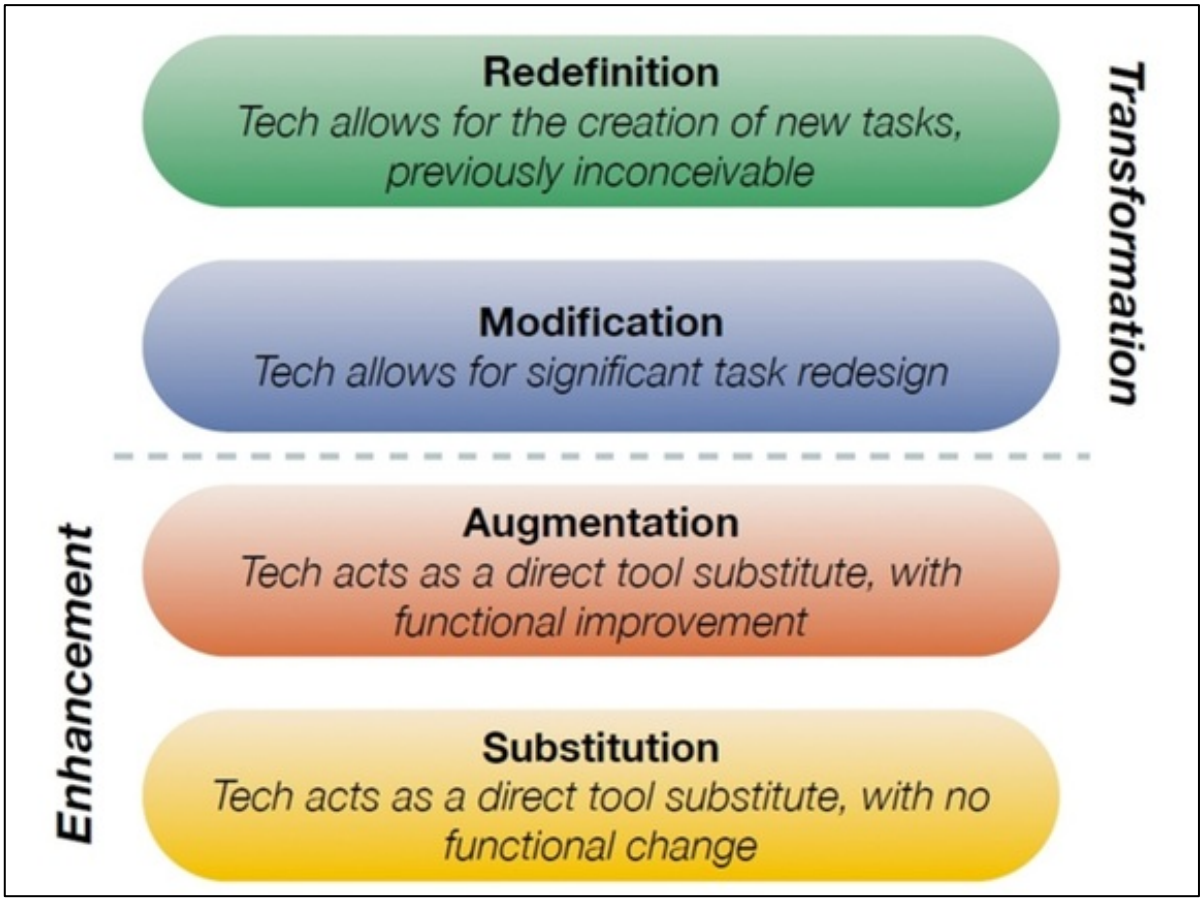

Figure 3-2. SAMR model (Puentedura, 2020)

This model categorises the use of digital tools in student learning from low levels to the advanced stage. The model considers that PSTs initially use technology as an alternative to traditional tools, after which they then enhance their practice with another technique, modifying their work to incorporate the participation of others in the implementation with the possibility of providing and sharing feedback with peers in the classroom. At the highest level in the model, students can design their own tasks through a digital programme to achieve high-level goals and skills that would not have been achieved without the ICT tools.

The TPACK model serves as an effective approach that has helped in making the easier transition between the education and technology methods, benefiting student learning (Koehler & Mishra, 2009; Walsh, 2015). At the same time, they can use SAMR framework in order to evaluate impact of technology used on their practice and plan ways further action towards more effective implementation. While its usage needs more guidance for both in-service and pre-service teachers (Gillespie, 2022), SAMR can constitute a solid template for further studies of educational technology that is lacking clearer theoretical explanation and standardization of interpretations.

With the use of technology using TPACK and SAMR frameworks, teachers are not only able to implement the use of technological components in their teaching practices but also improve students Nevertheless, the success of these frameworks is purely dependent on the level at which they are applied and adapted to meet the specific needs of teachers and learners. In particular, SAMR makes it possible to differentiate technologies used in basic and advanced levels by PSTs examples of which are shown in the Table 3-1. This distinction permits educators to move from simple applications towards more revolutionary uses of technology in the contemporary constant evolution of the world of learning.

Table 3-1. Examples of uses for SAMR model (Walsh, 2015)

Level	Example
Redefinition	Students create a report on programming software by making a video using film-maker software, connecting it to another programme, using social media to share it with other students around the world and evaluating their views on the report
Modification	In OneNote, the student produces a report with group members, supports the report with an audio clip created by the student and shares the work with the group members of the school and then shares it with the rest of the class
Augmentation	Writing a report in Microsoft Word and then submitting a link to the report to the instructor in partnership with members of the group
Substitution	Writing a report using Microsoft Word

SAMR is often advocated for its potential to enhance technology integration in education. However, its practical application and validity have been subject to scrutiny. Critics, including Geer et al (2017), emphasize the insufficient empirical research supporting SAMR's efficacy and the challenges educators face in accurately assessing activities within its defined levels. Despite these concerns, proponents argue

that SAMR offers a structured approach for educators to reflect on and improve their use of technology (Crompton & Burke, 2020; Geer et al., 2017; Hamilton et al., 2016). Enhanced actions, which include substitution and augmentation, focus on presenting content with computers/tablets, creating activities using hardware and physical assets, sharing materials and communicating using electronic media (Handoko, 2020). Transformational actions, which involve modification and redefinition, focus on leveraging digital technologies to create more dynamic activities and collaborating with colleagues in different ways. These transformational actions were less frequent than enhanced actions (Clark et al., 2020).

3.4.6 Combining TPACK and SAMR

Considering the above, the literature review presented in this chapter revealed several important implications. Therefore, pre-service teachers' limited use of the technology tools lessens the opportunity for these teachers' knowledge of and use of technology should be explored. Further, numerous factors including the ever-changing dynamics of such technologies affect the integration of technology in modern schools (Blundell, 2017). Thirdly, despite various studies in developed societies, more data is needed regarding pre-service teachers' TPACK and technology integration in developing countries such as an Arabic country. Moreover, no published research was found that holistically deals with teachers' TPACK & SAMR integration in self-efficacy and effects on learners' cognitive involvement as well as variables involved in a single study.

In this study, we will provide the Technological Pedagogical and Content Knowledge (TPACK) framework to pre-service teachers (PSTs) to help them understand the complex relationships involved in identifying the components educators need to effectively integrate technology into their teaching (Koehler & Mishra, 2009). Research in teacher education leverages the TPACK and Substitution Augmentation Modification Redefinition (SAMR) frameworks in various ways, including workshops, professional development and online resources. To implement these methodologies, teachers must emphasize the interconnectedness of technological, pedagogical and content knowledge. The SAMR model guides them in transitioning from substitution to transformation in their teaching.

In another study conducted by Tunjera and Chigono 2020 investigate how TPACK, SAMR models were used to train pre-service teachers for the use of technology in responding to 21st Century learners. Data generated from the eight pre-service teachers using in-depth interviews and participant observations. The results showed that the integration of technology in the very limited strategies and teacher-centred traditional approaches revealed on the enhancement levels of SAMR, were highlighted by teacher educators. It also indicated the added-up effect of insufficient preparation and absence of formation with CK, PK and TK on how pre-service teachers teach with technology.

The TPACK framework has been employed in Australia to prepare pre-service teacher and teachers to integrate technology into their teaching (Finger et al., 2015). In this study, teachers were asked to rate their confidence in using ICT and their perceived usefulness of ICT before and after exposure to the TPACK framework. The results showed improvements in the confidence of pre-service teachers to use ICT to support teaching. The authors made several recommendations for all educational institutions in Australia, including the establishment of leadership teams in each faculty or school responsible for teacher education to guide staff in the consistent application of the TPACK model (Finger et al., 2015, p. 511). However, a recent study by Al-Abdullatif (2019) in KSA revealed very low levels of interest among PST students in using ICT for personal, teaching and learning purposes.

Both the TPACK framework and SAMR model are employed in this study because each focus on different aspects of the research problem: the lack of knowledge and self-efficacy in the use of ICT by pre-service teachers. TPACK acts as a theoretical-behavioural foundation, focusing on what PSTs need to know. SAMR, on the other hand, emphasizes the practices and actions of PSTs and how technology influences their learning experience. Notably, there are significant parallels between the TPACK framework and SAMR models, particularly in relation to planning, assessment and evaluation of technology's use in teaching and learning (Kihoza et al., 2016; Tunjera & Chigona, 2020).

The integration of the SAMR model within the TPACK framework provides a comprehensive approach to technology integration in education. While TPACK underscores the interplay between technological, pedagogical and content knowledge, SAMR guides educators in moving beyond mere substitution or augmentation to

achieve more transformative uses of technology. This approach aligns with the goal of preparing pre-service teachers to effectively navigate the complex educational landscape, offering students meaningful and innovative learning experiences.

The SAMR model adds significant value to the TPACK framework, especially in assessing the extent to which technology can truly transform the learning experience. By combining both models, pre-service teachers can better evaluate their technology integration practices, aiming for the higher levels of the SAMR model, which encompass modification and redefinition. This approach empowers them to create innovative and impactful learning environments in line with the dynamic landscape of 21st-century education, especially as technology integration evolves in the context of Saudi Arabia.

3.4.7 TPACK, SAMR and Self-efficacy

The lack of ICT education for PSTs in their pre-service training, researchers in KSA suggest there are a lack of opportunities to practise using technology in Saudi teacher education programs (Alenezi, 2019; Alharbi, 2019; Almaiah et al., 2020). Therefore, to improve self-efficacy, PSTs may need more opportunities to experience ICT in teacher planning and implementation. Bandura (1997) argued that the most effective way to build self-efficacy is through mastery experiences. Mishra and Kohler (2006) describe TPACK as an extension of Shulman's (1986) characterization of more generalized teacher knowledge. They argue that knowledge forms the basis of effective technology integration into the teaching and learning process, linking technological knowledge, pedagogical knowledge and content knowledge in the digital age, thereby establishing productive student-centred learning. In contrast, the SAMR (Substitution, Augmentation, Modification and Redefinition) model illustrates the levels of change or actions that new technology adopters frequently pursue as they advance technology practices in their teaching. The significance of PSTs using the SAMR model lies in the need for support to shift from conventional teacher-centred teaching practices to student-centred, constructivist methods enhanced with ICT technologies (Tunjera & Chigona, 2020).

Stinken-Rösner et al. (2023) investigated the effects of technology-enhanced modules on pre-service teachers, focusing on the TPACK and SAMR models. The study revealed a progression in the integration of technology, moving from basic

substitution to more advanced levels such as augmentation, modification and redefinition. This developmental shift indicated that pre-service teachers experienced positive improvements, showcasing an enhanced ability to transform and elevate learning experiences in science education through the effective use of technology.

The study by Tunjera and Chigona (2020) highlights the importance of providing proper Technological Pedagogical Content Knowledge (TPACK) intervention skilling for eight teacher educators to facilitate a transition from basic enhancement to transformative teaching practices. This specific study focussed on eight teacher educators, and it brings attention to the individual experiences and needs within the larger group, emphasizing the significance of tailored interventions for skill development. Examining how these teacher educators navigate TPACK intervention skilling offers insights into the challenges and successes at an individual level, contributing to a nuanced understanding of effective strategies for pre-service teacher preparation.

Finally, after reviewing the studies in the literature, much of the SAMR research can be seen to have involved PSTs in developed, Western countries rather than in developing nations such as Saudi Arabia (Martin, 2020). Further research is therefore needed to determine whether implementing the TPACK framework and SAMR model would have a positive impact in developing Arab countries, such as Saudi Arabia in teacher education programs.

The purpose of this research is to investigate the use and integration of practice lessons in teacher education along with the implementation of those lessons by teachers during field placement. This study will investigate the perception of and use by pre-service teachers on instructional models in planning and teaching, as well how field placement experience contributes to improved ICT integration into effective practice.

This research also has potential benefits for my practice as a teacher-educator specializing in courses on the ICT integration, of an Educational Technology Programme (ETP) (as detailed in section 1.2). Furthermore, it can help the pre-service teachers reflecting on their experiences and stimulate them to be creative in utilizing ICT within their lessons using what they already know.

To effectively integrate ICT in teaching, Mishra and Koehler (2006) proposed the Technological Pedagogical Content Knowledge (TPACK) framework, which emphasises that pedagogy must be connected to content in order for ICT to be effectively integrated into education. According to the TPACK framework, there are three basic types of knowledge required by teachers: Technological Knowledge (TK), Content Knowledge (CK) and Pedagogical Knowledge (PK). It is evident from Figure 3-1 that the three domains in TPACK are interconnected entities, rather than being separate entities as described in Section 2.7.

Pre-service teachers can apply the SAMR model to reflect on their technology use (Puentedura, 2013). Using SAMR in the classroom can change perceptions about the use of technology. Pre-service teacher professional development would be affected by using the SAMR model. This will also enable pre-service teachers to become aware of the types of technology and improve their own teaching, which will in turn benefit their students (Tsybulsky & Levin, 2016, p. 3). Technology perceptions have changed significantly in pre-service teacher research. Traditional teacher perceptions of technology changed during the course of study; the teachers began viewing technology as more than just a tool to enhance learning (Tsybulsky & Levin, 2016).

According to Peciuliauskiene et al. (2022) and Pozas et al. (2022) more research is needed to determine how pre-service teacher self-efficacy affects how technology is used in the classroom. This study seeks to close this gap by researching how pre-service teachers in Saudi Arabia build their self-efficacy for technology integration and translate it to classroom practise. Due to the focus on a Saudi Arabian setting, this study is distinctive and has the potential to increase ICT integration in the classroom and teacher education programme s.

3.5 Assessing Self-efficacy

This section contains the following sub-sections:

- Introduction
- Teacher Self-efficacy and Its Effect
- Development of the TSES
- Evidence from Use of TSES

- Cultural Adaptation and Validation of TSES
- Technology Integration and Expanding the TSES
- Justification for Choosing the TSES

3.5.1 Introduction

Self-efficacy refers to readiness and confidence in one's own capabilities. In terms of pre-service teacher education, self-efficacy plays a very important role (Section 3.2). The capacity to provide learning activities through the appropriate technological means is very important determinant of effective educational goals. This statement coincides with the wider study, which suggests that technology in education is improving the self-efficacy among many language lecturers. Eventually, the readiness and trust in the appropriate implementation of technology into teaching methods are very paramount when establishing an environment that is not only technologically friendly but also favourable for the student engagement and success (Williams-Buffonge, 2021; Akram et al., 2021; Drajati et al., 2021; Saienko, 2020).

Kazu and Pullu (2023) investigated the relationship between cognitive flexibility levels among pre-service teachers and their teaching self-efficacy perceptions. The results showed that both cognitive flexibility levels and teaching self-efficacy perceptions were high, with higher cognitive flexibility level among female pre-service teacher than males, as well having grade point averages, having higher cognition improvement motivation scores.

3.5.2 Teacher Self-efficacy and Its Effect

According to Bandura (1997), teacher efficacy was the belief that a teacher could produce desired impacts in student engagement achievement and learning. Perceived teaching efficacy relates positively to effective teacher behaviours, greater levels of student achievement, openness towards innovation and a commitment enhancing attention on low-performing students (Hoy & Spero 2005; Tschannen-Moran & Woolfolk Hoy, 2001).

The theoretical framework of efficacy provided by Bandura underpins an understanding how teachers' beliefs about their capabilities define teacher behaviour and affecting student achievement. A teacher with a high sense of efficacy appeared enthusiastic, had higher job satisfaction and lower burnout scores (Caprara et al.,

2006; Friedman, 2003; Schwarzer & Hallum, 2008). Notably, the importance of efficacy in teaching profession was also supported by its correlation with a successful performance within teacher's work and effective functioning within school structure.

3.5.3 Development of the Teacher Sense of Efficacy Scale (TSES)

Tschannen-Moran and Woolfolk Hoy (2001) noted the shortcomings of existing tools at the time. They proposed a new tool the Teacher Sense of Efficacy Scale (TSES).

This scale, comprising 12 items in short scale, measured teacher efficacy across these factors:

- Instructional strategies
- Classroom management
- Student engagement

Instructional strategies measure teachers' ability to establish an environment that is conducive for learning and processes of effective learners. Classroom management efficacy refers to the effectiveness with which teachers manage student discipline and behaviour. Student engagement efficacy is a measure of how much a teacher believes in facilitating positive attitudes and toward schoolwork among students.

The introduction of these sub-dimensions showed that the approach was inclusive and attempting to understand teachers' self-efficacy holistically depicting the fact that effective teaching essentially is a blend of multiple skills. The construction of the TSES facilitated a refined evaluation that extends beyond an overall value, granting information on distinct elements affecting effective teaching.

3.5.4 Evidence from Use of TSES

In different preservice contexts, the Teacher Sense of Efficacy Scale (TSES) has been employed to assess individual's self-efficacy perception. Research has investigated the relationship of how much a preservice teacher's cognitive flexibility level could impact the perceptions they have about their own level of teaching self-efficacy (Kazu & Pullu, 2023). A version of the TSES has been assembled for use in Spain, with construct structure consisting of three factors and 17 items (Bueno-Álvarez et al., 2023) regarding its consistency and legitimacy. Several aspects of the factors structure regarding its 12-item TSES have been investigated in the Vietnamese educational

context and Ho et al. (2023) show that it has some form of three-factor scaling apt for high school teachers. Likewise, in the Vietnamese setting where TSES has been translated into 24 items and validated among a test group of graduate students to yield a three- factor structure (Tran, 2023). Since a study that was conducted in Indonesia, the questionnaire used Teacher Sense of Efficacy Scale (TSES) to measure pre-service teachers' sense of efficacy and feel about dealing with their students while teaching English as foreign language (EFL) (Safitri, 2021).

In a similar study, Tran (2023) explored the validation of the factor structure for Teacher Efficacy Scale conducted among in-service teachers' indicators that has been established to have such strong influence on both outcomes such as results related to behaviour and performance of learners and given its successes across various learning institutions. While these developments have seen there are some repairs in this area, however, it is glaring that a research gap exists about the factor structure of scale with regards to Vietnamese education system. To do so, Tran's research critically analysed the Vietnamese version of TSES with 24 items from among 397 practicing high-school teachers. The results corroborated the validity of using the three-factor version of the original TSES, including one factor representing efficacy for use with instructional techniques, another related to managing and mediating classroom behaviour and a final item that focused on student involvement. This study supported the usefulness of TSES in measuring Vietnamese teachers' efficiency within its weak and strong point, while further explorations were encouraged to extend TSES measurements onto primary and secondary level participants too.

Bueno-Álvarez et al. (2023) sought to collect evidence on the reliability and validity of a Spanish version of TSES using data from an adult group comprising future teachers in Spain. This study offered support for the validity of a three-factor construct with 17 items, lending credence to convergence and consistency in construction predicting teachers' overall self-efficacy. The study used a rigorous scrutiny of 744 pre-service teachers measuring teacher sense of self-efficacy as a determinant of quality education. In addition, the study attempted validation of a Spanish TSES in the process. The research using confirmatory factor analysis and decision trees uncovered three-factor construct with 17 items, showing healthy fit indices. The study showed strong evidence indicating that the validity of this tool is

central in predicting overall teacher self-efficacy among undergraduate and master students within the sample.

Ho et al. (2023) investigated the factor structure of TSES for in-service teachers, Vietnam and concluded that three factors from original sources are relevant to high school teachers working within Vietnam. The study suggested that future studies should consider the factor structure of TSES applied to pre-service teachers in Vietnam for comparison between efficacy beliefs coming from these two groups.

Tran (2023) researched the factor structure of Vietnamese TSES for in-service high school teachers within Vietnam's education system. The study revealed that the structure of three factors represented as efficacy for instructional techniques, efficacy for classroom management and student involvement brought from TSES is valid in Vietnamese.

In Safitri (2021), a TSES questionnaire was included into an evaluation of self-efficacy in pre-service teachers within English Foreign Language in Indonesia. The questionnaire had 103 respondents. Findings revealed that pre-service English teachers scored better in instructional strategy with an average score of 3.78 on the overall sense of efficacy questionnaire items based on a scale of 1 to 5. Next, student engagement efficacy and an average of 3.75 are followed by class management with the score of 3.73 as last in this list. From the gathered data, it is revealed that a moderate degree of efficacy existed among students. The pre-service English teachers in Indonesia had a high sense of efficacy level.

Another work in this area that was further explored extension the investigation of TSES's factor structure and its consequences on teacher outcomes. This hypothesis-driven inquiry focused on the Vietnamese field of education and uncovered a large research gap related to the factor structure of TSES. Ho et al. (2023) empirically researched a 12-item TSES with 395 in-service teachers in Vietnam. Findings showed that the factor structure validity for high school educators was retained as, largely not have been fully supported within original three-factor structure set on TSES. The study advocated for the use of TSES in testing self-efficacy for Vietnamese teachers and proposed to expand this project for pre-service teachers.

In a similar context, Johar's (2023) study focused on the construct-wise evidence of TSES within a Malaysian educational jurisdiction. The research used a 24-item scale

of TSES with a purpose to determine its factor structure using Confirmatory Factor Analysis. The findings revealed a 9-item scale structure with three components that are appropriately measured by the scale, thus demonstrating psychometric validity for use among Malaysian in-service teachers.

Supplementing the discussion, Lazić et al. (2024) investigated factor structure by using the short form of TSES and Confirmatory Factor analysis followed by path analytics analyses for Exploratory Structural Equation Modelling and bifactor models. The study tested two measurement models with 295 elementary level teachers to investigate their information communication technologies usage. This research proposed the use of bifactor models as a beneficial structure for assessing both facet validity and dimensionality of TSES.

Lu, et al. (2021) collected data from the special education teachers in China for 423 participants and confirmed that the factor structure of TSES is stable with good reliability. In Malaysia, Khairani and Razak (2012) conducted a study on 191 in-service teachers and 122 pre-service teachers to assess the psychometric properties of the Teachers' Sense of Efficacy Scale (TSES) within the context of Malaysian education. The results demonstrated high agreement in item difficulty and teachers' efficacy which indicated the overall strong reliability and construct validity. It was remarkable that 13 items demonstrated behavioral differences between in-service and pre-service teachers. Nevertheless, the study was largely in favor of the applicability of the TSES for the assessment of a teacher's sense of efficacy in Malaysia.

In summary, there is general support for the use of TSES. Many researchers have tried to validate and investigate the TSES scale's reliability in various cultural and educational settings. Tran (2023) conducted a critical study of the Vietnamese version of the TSES to confirm the validity of the three-factor structure which includes the efficacy for instructional techniques, classroom management and student involvement. Likewise, Bueno-Álvarez et al. (2023) proved the reliability and validity of a Spanish version of TSES among future teachers in Spain. The results of their research suggested a three-factor model comprising 17 items, which proved to be a strong predictor of the overall teacher self-efficacy. Such as that, Ho et al. (2023) also studied the factor structure of TSES for in-service teachers in Vietnam and its relevance to high school educators. This model has been applied variously across academic disciplines using a three-factor model (Bueno Alvarez et al., 2023; Ho et al.,

2023; Tran, 2018) on the other hand, with a nine-item scale as proposed by Johar (2022). However, these differences reveal the adaptability of the Teachers' Sense of Efficacy Scale in terms of its ability to match different structure factors differentiating between levels or different components of a particular educational setting. In summary, these concomitant studies are sought in extending the scope of the research to establish the detailed effect of the Teachers' Sense of Efficacy

As a worldwide instrument popular for measuring the self-efficacy of the teachers, TSES has been validated thoroughly, indicating its cultural and national cross applicability.

3.5.5 Cultural Adaptation and Validation of TSES

The cultural adaptation of test tools is an important process that ensures their applicability in various educational contexts. Various adaptations of the cultural specificity of TSES have been made to allay any concerns about the scale.

The TSES-12 items were validated in France following a study by Benoit and Vall (2020), who determined the French translation of the scale to be reliable, proving its applicability during inclusive education reforms. By incorporating cultural subtleties, the TSES had an adequate representation from a global perspective and captured the intricacies of teacher self-efficacy in different cultures. Similarly, the TSES was also researched by Benoit and Vall (2020) in a study carried out in Macao in which both long version and short versions of this scale were evaluated. Results indicated the scale it is reliable in a Chinese context.

Although the TSES is widely used, little empirical evidence on its psychometric characteristic cross-culturally has been recorded. That limitation justifies a broad study to facilitate our knowledge of TSES in the special cultural environment of Saudi Arabia, revealing a lot about its applicability and validity in this particular educational setting (Abdul Rahim et al., 2008; Khalid et al., 2009).

These cross-cultural studies emphasized the need for recognizing the universality of TSES in portraying the teacher self-efficacy across different contexts globally.

3.5.6 Technology Integration and Expanding the TSES

Educator self-efficacy beliefs towards using technology for integration into their teaching practice were among the major determinants of utilization and

implementation of technology found by Gomez et al. (2021). Moreover, although a positive correlation is observed between self-efficacy and technological integration, recent studies have revealed that the integration of technology is still a major problem faced by educators today (Williams-Buffonge, 2021; Saienko, 2020)

The double-sided narrative about technology integration as an important manifestation of educators' capability and readiness, which is at the same time a fundamental challenge requires elaboration. It encourages teachers, researchers and policymakers to seek the true nature of how technology integration links with their self-efficacy. By solving these issues that educational stakeholders can open up for the successful implementation of technology into instructional processes, better education quality and learning outcomes are achieved.

Section 3.5.3 discussed the development of the TSES. The initial development included three factors. Saienko et al., (2020) introduced a fourth factor: Education Technologies Implementation. This factor focussed on teacher efficacy with integrating educational technologies into their teaching. It targeted the effective and purposeful interplay of teaching capabilities, including engagement between student and technological pedagogical content knowledge in formal education by university learners.

This enhancement reflected the reality of current educational environments, in which technology is closely related to teaching strategies. It ensured that the TSES remains appropriate as it measures teacher performance not only in conventional areas but also effectiveness with innovative tools.

The expanded TSES scale therefore measures teacher efficacy across the following factors:

- Instructional strategies
- Classroom management
- Student engagement
- Education technologies implementation

3.5.7 Justification for Choosing the TSES

Given the intention of the Kingdom of Saudi Arabia of integrating technology in education at most levels, the inclusion of such factor as Education Technologies Implementation within TSES is specifically relevant to Saudi. Realizing the changing face of technology as a tool used in Saudi classrooms, this scale remains relevant to contemporary educational landscape. The self-efficacy of the teachers with respect to their ability to effectively harness technology is increasingly gaining recognition as a significant determinant in terms of developing interesting and creative learning environments (Robertson & Al -Zahrani, 2011).

In summary, teachers' sense of self-efficacy deserves a space in the discussion and recognition for its role can significantly shape educational practices as well as outcomes. This construct has been captured using the Teachers' Sense of Efficacy Scale (TSES) that offers a multidimensional approach beyond one universal measure. It has undergone adaptation and validation in different cultural settings, further demonstrating its possible relevance to the Saudi Arabian teacher preparation system. Although the TSES has shown reliability and validity, there is still scoped to investigate its psychometric qualities in Saudi context. Through a thorough study, particularly within the Saudi Arabian context would shed light on its applicability and validity in such as cultural setting of education.

3.6 Chapter Summary

The literature review in this chapter is organized under specific headings and covers several topics relevant to the research. In the first section, early teacher education plays a significant role in preparing pre-service teachers. A discussion of how teacher self-efficacy impacts teacher performance and development is presented in Section 2.4. Section 2.5 explores the relationship between self-efficacy, learning outcomes and educational technology. Finally, section 2.8 explores how PSTs may be prepared for future technology integration in the classroom by using Technological Pedagogical Content Knowledge (TPACK) and Substitution-Augmentation-Modification-Redefinition (SAMR) models. The chapter ends by describing the methodology that will be used in the upcoming chapter to collect and analyse data.

As the literature review builds a substantial platform by investigating major aspects of early teacher education, teachers' self-efficacy and how internal efficacy impacts learning results and educational technology integration; strategic use of TPACK And SAMR models for training future educators shape forthcoming methodology chapter via transforming these findings into practical research initiatives. Making use of the teachings gleaned from literature, the methodology chapter delineates how we approached this research with respect to our approach toward a chosen strategy and methods of data collection as well as analytical strategies that were guided towards answering these main posed questions and objectives. In regard to the complexity of what was studied, the smooth transition from the literature review to the methodological framework demonstrates a well-thought-out and well-coordinated approach to unravelling such complexity.

The chapter concluded with a review of the importance and measurement of teacher self-efficacy. Development of the Teachers' Self-efficacy Scale (TSES) was described, along with studies of the reliability and validity of the scale and its application in multiple cultural settings.

4. Methodology

This chapter contains the following sections:

- Introduction
- Research Design
- Research Paradigms
- Research Methodology
- Trustworthiness of the Study
- Data Collection and Research Tools
- Data Analysis Procedures
- Reliability and Validity of the Self-efficacy Survey
- Quantitative Data Analysis
- Qualitative Data Analysis
- Ethical Considerations
- Chapter Summary

4.1 Introduction

This chapter begins with an overview of the research design framework that underpins the research program, followed by an explanation of the specific components of the framework and the research methodology. It justifies the general approach used as well as the data collection methods used in the study program. The chapter also addresses the researcher's responsibility in the study process as well as applicable ethical concerns.

4.2 Research Design

The philosophical underpinnings and assumptions or the research paradigm, the theoretical perspective, the methodology and the methods are all part of the research design framework that supports the research, as shown in Figure 4-1.

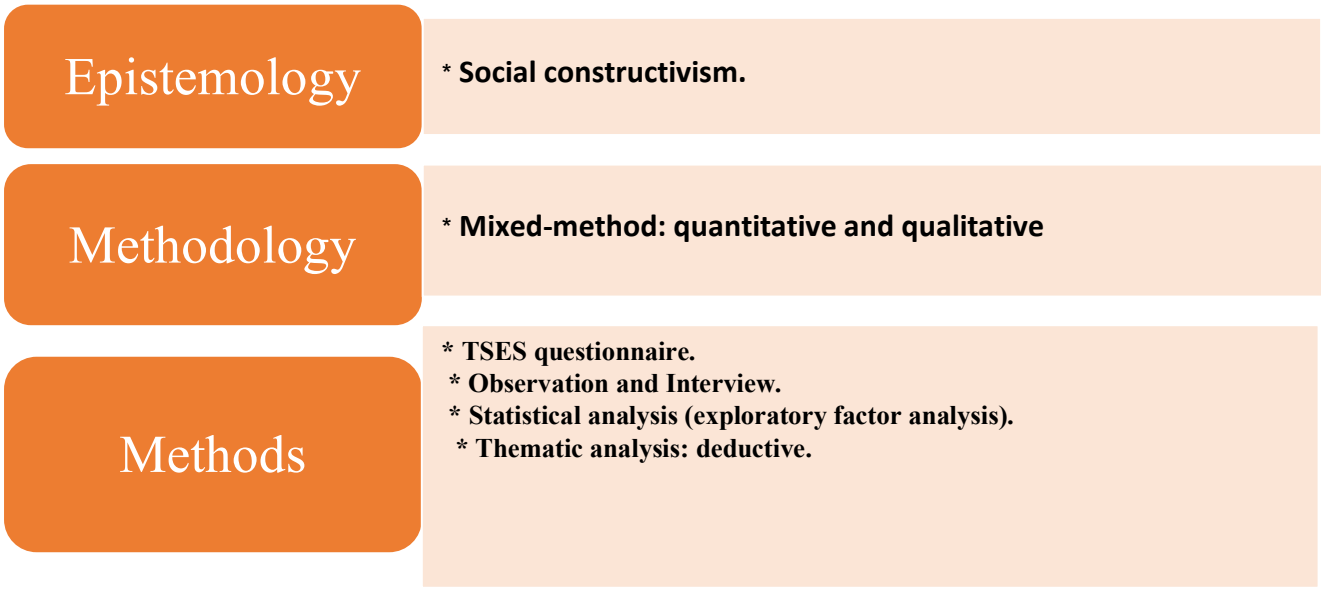

Figure 4-1. Embedded **sequential explanatory design used in this study.**

Understanding these factors, as well as the impact of each on the others, is a critical consideration in the implementation of research (Creswell, 2014; Flick, 2018). In this programme of studies, the use of a mixed-methods case study design enables both qualitative and quantitative data to be collected from PSTs to identify ICT integration levels. Therefore, the researcher has developed several cases to explore their similarities and differences (Creswell & Poth, 2016; Miles & Huberman, 1994; Yin, 2003).

4.3 Research Paradigms

This section begins with an overview of paradigms, followed by an explanation of how the Pragmatist paradigm has shaped this research and its philosophy. Understanding research philosophy is vital in any study because it can guide decisions made during the research process (Saunders & Lewis, 2012). Research philosophy concerns knowledge development and the nature of such knowledge and is usually discussed in terms of ontology and epistemology. Ontology relates to what is individually known in a particular field of study (Sparkes & Smith, 2013), whereas epistemological considerations are concerned with interactions with others and knowledge which is developed through interaction with others and related to or dependent on prior experiences and beliefs (Ward et al., 2015). Using a constructivist lens, researchers believe that each individual constructs their own knowledge (Crotty,

1998). Constructivist theory has multiple roots, yet all constructivist perspectives share a fundamental idea that the development of understanding requires the learner to actively participate in forming meaning from new experiences by building on and integrating previous knowledge and experiences (Jones & Brader-Araje, 2002; Vaughan et al., 2013). This research uses a constructivist theoretical structure which is most appropriate since it aligns with the epistemological and ontological foundations of knowledge development and learning in this study.

4.4 Research Methodology

The following subsections provide an in-depth examination of the study's mixed-methods research approach, case study methodology, research context, participants, educational technology programme (ETP) and the role of reviewers:

- Mixed-Methods Research
- Case Study
- Research Context
- Participants
- Educational Technology Programme (ETP)
- Approach and Methodological Integrity

4.4.1 Mixed-Methods Research

A mixed-methods research design is a process for collecting, analysing and integrating quantitative and qualitative data. Some studies are more suited to either quantitative or qualitative approaches, while others are more suitable for a mixed-methods design.

This study used an embedded sequential mixed- methods approach (Creswell & Plano Clark, 2007), within this approach, combining quantitative and qualitative techniques. This concept of mixed-methods research assumes that integrating quantitative and qualitative approaches offers a deeper understanding of the issues being researched than using either approach alone (Creswell, 2012). A mixed-methods case study involves the researcher examining contemporary events in a real-life context and developing an in-depth analysis by collecting qualitative and quantitative data from

multiple sources and in different periods to present a clear, integrated picture of the case (Creswell & Poth, 2016; Miles & Huberman, 1994). Therefore, in this research, a mixed-methods case study design has enabled both qualitative and quantitative data to be collected from PSTs to identify ICT integration levels so that the researcher can create scenarios to investigate similarities and differences among PSTs (Yin, 2003).

4.4.2 Case Study

Yin's (2003) explanatory case study framework is designed to explore “how” and “why” questions within their real-life contexts, focusing on understanding causal relationships. This framework is particularly valuable when the researcher seeks to investigate complex phenomena where the boundaries between the phenomenon and context are not clear. The key components of this framework include defining the study questions, which guide the overall research design and data collection methods, and establishing propositions that direct the research focus. Additionally, it involves defining the unit of analysis, linking data to propositions through methods like pattern matching and explanation building, and setting criteria for interpreting findings to ensure robust conclusions (Yin, 2003). This structured approach helps to uncover the underlying mechanisms and interactions within the studied phenomenon, making it a robust tool for educational research.

An explanatory case study is highly suitable for this research, which aims to explore how pre-service teachers' self-efficacy influences their adaptation of educational technology models such as TPACK and SAMR. This approach is ideal for understanding the causal mechanisms underlying these adaptations and the complexities involved in real-life educational settings. The holistic nature of the explanatory case study allows for a comprehensive examination of multiple cases (nine pre-service teachers), providing a detailed understanding of how self-efficacy impacts technological adaptation. Furthermore, the flexibility in data collection methods such as interviews, observations, and lesson plan enable the researcher to gather rich, detailed data that can illuminate various aspects of the teachers' experiences and the factors influencing their technological integration (Abbas et al., 2019; Ferri et al., 2020; Tijan et al., 2019).

The suitability of an explanatory case study for this research lies in its ability to address the complexity of educational settings and the nuanced experiences of pre-service teachers. By focusing on specific instances within the broader context of Saudi education, this approach allows for detailed insights into how pre-service teachers' knowledge, experience, and self-efficacy evolve through their participation in the ETP and PPE. This method also supports the investigation of what drives changes in self-efficacy and the identification of potential barriers. Thus, the explanatory case study framework provides a robust structure for answering the research questions and contributing valuable insights to the field of educational technology and teacher preparation.

4.4.3 Research Context

Knowing the environment of the participants in a study is critical for conducting efficient analysis and providing deeper interpretations (Van der Veer, 2007). For this study, I chose a context, environment and scenario that is familiar to me in order to better comprehend the context of my study participants. Accordingly, I opted to conduct my research where I have been employed for five years as an educator at the selected university on women's campus preparing the PSTs for the use of technology in their teaching careers.

This university is situated in the southeastern region of the Kingdom of Saudi Arabia and was established in the early 2000s. It is one of the largest in the kingdom with a variety of colleges offering admission to a capacity of 45,000 students studying at separate campuses for women and men.

The study examined self-efficacy of female undergraduate students enrolled in teaching degree courses at the university before and after they had participated in an educational technology course (Section 4.4.5). Thus, the research explored various PST outcomes from the students' enrolment, learning and skills development in the course, all while upholding stringent measures to protect participant identities.

Students enrolled in the Educational Technology course were chosen for this research as the main aims of the course are to introduce theories and practice for use of instructional technology for student teachers' pre-service learning and teaching with ICT. This course is mandatory for all PSTs from various teaching disciplines (for

example, Mathematics, Science, Computing, Islamic Studies, Kindergarten and English) and is conducted in the final semester of the final year of the degree. Participation in the study was voluntary, with no coercion, disadvantage, or reprisal for students if they chose not to take part.

4.4.4 Participants

There were 132 female undergraduate pre-service teachers participating in the research, which took place at the Saudi University for Women. Participation in the research was available to all PSTs enrolled in the Educational Technology and professional placement experience who had successfully completed all previous degree requirements, in preparation of becoming a qualified teacher. In the Saudi Arabian tertiary education sector, males and females' study on different campuses and are taught by professors and lecturers of the same gender. As a result, only female students participated in the course. All PSTs were Saudi nationals, aged from 21 to 23 years and spoke Arabic as their first language. Of the 132 PSTs, 97 responded to the initial invitation to complete the Teacher Self-Efficacy Scale and 9 volunteered to participate in the observations and interviews.

Due to its small size, the sample is homogeneous, and all respondents are studying at the same university and academic program. Furthermore, participants have relatively uniform knowledge on their subject, pedagogy and technology and we expect that they will regularly exchange ideas and experiences. The teaching specializations of all PSTs on the course are shown in Table 4-1. The pre- and post-course surveys of 132 pre-service teachers were unable to be matched (except for approximately 12 teachers) due to confidentiality issues. The specifics of the PSTs consenting to be on pre- and post-survey are contained in Section 6.3.

Table 4-1. Enrolled PSTs with academic discipline

PST Participants	Specialization
21	Kindergarten studies
45	Islamic studies
11	English
18	Computer science
12	Chemistry

PST Participants	Specialization
10	Mathematics
15	Not provided
132	Total

4.4.5 Educational Technology Programme (ETP)

The Educational Technology Programme (ETP) at the university is a new undergraduate mandatory module that supplements the current study programs by emphasizing technology use in classes. ETP are offered over twelve weeks (12 weeks by 2 hours), in conjunction with a professional placement experience and comprised of a set of lectures, workshops and learning activities provided to PSTs, in conjunction with the practical teaching component through a Professional Placement Experience (PPE). Specific topics each week were designed to build PST skills and knowledge around the main topic. New topics were introduced on a weekly basis. PSTs were then immersed in collaborative activities, working together to assess their use of technological tools in the classroom and refine their approaches based on peer and supervisor feedback.

In the context of this research, Pre-Service Teachers received detailed instructions for each task, aiming to design practical classroom lessons that incorporated technology to enhance student learning. Guided by the TPACK and SAMR frameworks, pre-service teachers were encouraged to justify their choices and decisions, showcasing how these theories are applied to their specific tasks. For a visual representation of the typical weekly tasks, see Figure 4-2.

Figure 4-2. Process page for a typical task

The ETP was designed and implemented through three steps: taught, practiced and assessed, according to a course timeline shown in Table 4-2. Implementation of the lessons took place in the Educational Technology classroom and online remotely. In the "taught" sessions, the participants took part in workshops and lectures that supported the development of knowledge on how to integrate the featured technologies into planning content and teaching to enhance learning. The practice step provided the participants with opportunities to practise, discuss and analyse with their peers the most recent information they were taught on designing an ICT integrated lesson. This approach was taken as Jimoyiannis (2010) purported that teachers can create teaching materials through practical training, teamwork in design teams and receiving feedback from their peers. A structure for assessing the use of ICT activities in the classroom was provided through the SAMR model (Puentedura, 2013).

Table 4-2. Timeline of activities in ETP course

Activity	Aim	Week
Workshop	• Implementation of the TPACK framework and SAMR model • Discussion on collaborative lesson planning in teacher training teams • Implementation of collaboration guidance • Activities for different online learning resources • Exemplary lessons analysis	1
Lesson design in design teams	• Using the expert's exemplary lessons, PST work with their peers to plan and integrate technology in lessons. • Searching on online learning materials	2-4
Workshop - reflection on the lesson	• Practicing to design lessons with technology based on the TPACK framework & SAMR model	5
Lesson implementation	Implementation of a new lesson and observation from the researcher in a micro-teaching.	6
Lesson re-design	• Feedback from the researcher and peers and discussion about how the lesson might be improved in the latest design lesson	7-9
Lesson reimplementation	• In the classroom, the latest design lesson will be taught and assessed by the researcher	10-12

4.4.6 Approach and Methodological Integrity

The Saudi University department in charge of the study's application had mandated that two reviewers from the Department of Education faculty follow up and discuss the study's application with the researcher and suggest applicable recommendations. Before starting the application of the study tools, I met with the designated reviewers to discuss the tools and the principles on which they are based and to identify solutions to encourage and facilitate the participation of the students in my research. During the meeting, the goals and objectives of the study were presented and explained, as well as the tools for this research and how they would be used. After that, another meeting was held to discuss their role in building a good relationship with the students and encouraging them to participate. During these meetings, emphasis was placed on the importance of gaining the support and willingness of the students while also reassuring them that participation would be voluntary and that the research had significant value in terms of impact in supporting development and community service. For example, the assessment model for integrating technology into the classroom and its criteria were discussed to show how the Lesson Draft would be evaluated

accordingly. These meetings continued through the semester on a need's basis. For example, there was a problem with the way students evaluated each other in lessons and this was resolved by evaluating and discussing existing models. After that, the reviewers met with the supervisors of the students and explained to them the mechanism and objective of the study.

As a result of these arrangements, a good relationship was built up between the students and the reviewers by arranging suitable times for discussion and the students seemed comfortable in presenting their views and discussing their requirements without worry or embarrassment. Cultural and religious commonalities with participants enrich my insights, enabling a deeper understanding illustrated through pertinent examples. The shared linguistic ground fosters effective communication, demonstrated through instances where I effortlessly grasped participants' expressions. I candidly address challenges posed by colloquial language, outlining adept strategies for resolution. Upholding ethical standards throughout, I ensure the integrity of my research This helped me to establish and maintain a good relationship with the participants who became more confident and trusting in sharing their views. This approach proved to be important to the success of study, because incorporating these two reviewers in several aspects of the research process improved the credibility and dependability of the current study, as described more fully in Section 4.5.

4.5 Trustworthiness of the Study

Issues of trustworthiness are discussed in the following sub-sections:

- Introduction
- Credibility
- Dependability and Confirmability
- Transferability
- Triangulation
- Back Translation
- Member Check

- Peer Validation

4.5.1 Introduction

The reliability and validity of qualitative research contribute to trustworthiness. Using reliable and valid measurements is the difference between consistency and validity (Merriam, 1998). An important distinction between qualitative and quantitative research is how it addresses reliability and validity. Denzin and Lincoln (1994) recommended that qualitative studies assess the validity, reliability, concordance and transferability of their findings rather than using the reliability and validity more relevant to quantitative studies. For details on reliability and validity in quantitative research, see Sections 5.3 and 5.4. To determine internal validity, the researcher discussed reliability and transferability and referred to dependability instead of reliability or transferability (Merriam, 1998).

4.5.2 Credibility

Through strategies such as triangulation, member checking and auditing, researchers can verify the credibility of their findings and interpretations. It is a method of establishing credibility by correlating evidence from multiple sources such as participants, data types, or data collection methods (Creswell, 2012). By providing interview transcripts or research findings to research participants and asking them to comment on completeness or accuracy, member checking enhances credibility (Creswell, 2012). A triangulation and member checking process was used to confirm credibility in this study. Triangulation involved various data sources such as sustained surveys and interviews as well as classroom observations were used by the researcher to assess credibility. After each interview, the researcher read a summary of the discussion with each participant and asked him or her if the summary was accurate and complete.

4.5.3 Dependability and Confirmability

The reliability of a study refers to the consistency and dependability of the collected data (Lincoln & Guba, 1985). It ensures that repeating the same procedures and case study will yield consistent outcomes and conclusions (Yin, 2003; Cohen et al., 2000). In qualitative research, reliability is established through methods such as member checks, back translation and triangulation, which are the same measures employed to verify the credibility of findings (Lincoln & Guba, 1985). The maintenance of

research audit trails (Lincoln & Guba, 1985) serves as evidence of the researcher's reflections and thoughts, justifying all decisions made throughout the research process.

Keeping an audit trail and a reflection of findings in a journal, memos, field notes and transcripts provide the researcher and the reader with the opportunity to assess conformity. Throughout the research process, I ensured transparency and accountability by documenting my thoughts, reflections and reasoning for all decisions.

4.5.4 Transferability

It is the capability of transferring the phenomena under study to another setting that is considered transferability (Lincon & Guba, 1985). A qualitative study's transferability is equivalent to a quantitative study's generalisability, or external validity. It is necessary to demonstrate that the findings of a research study are transferrable to other contexts, situations, times and populations to establish its transferability. The researcher provided readers with a detailed description of the research design, data collection procedure, sample selection and data analysis steps of the research process. A researcher's work can be assessed and applied to other situations if it is transparent, communicable and coherent.

4.5.5 Triangulation

To increase the quality and validity of the qualitative results, researchers and academics seek to define specific criteria to ensure the validity of their results (Lincoln & Guba, 1985). In this study, the researcher used multiple data sources (triangulation) to address credibility, such as sustained survey, interviews, classroom observation and focus group (Lincoln & Guba, 1985; Yin, 2009).

These different methods helped check for consistency between what the respondents said, what they said in the interviews and the focus group and class observations. For example, the results of their perceptions of self-efficacy gathered through the survey were supported by their data from interviews, focus groups and observations in class notes. The researcher used methods such as interviews, classroom observations and lesson plans to triangulate and further support the evidence from the questionnaire.

4.5.6 Back Translation

To check the validation of the translation data was collected and analysed in Arabic language and then translated into English by the researcher. The Arabic and English transcripts were checked for accuracy by native speakers to produce trustworthiness of the data and generation and translation of the themes. To ensure the quality of the data, the translation was initially done in English by the researcher and then transferred to a specialized native speaker to produce the reliability of the data using the back-translation technique (Son, 2018). The proof-reader for translation was Arabic speaking and fluent in English. Her studies included English literature and teaching methods. She has translation experience in several centres such as: English language trainer at Accent Centre, translator of Al-Ghaida magazine at WAC for Women's Affairs, content writer and online English language trainer.

4.5.7 Member Check

To confirm the correctness of the data captured from the interview transcripts and case studies, participants' feedback was gathered. This method entails giving the study's findings and transcripts back to the participants so they may consider the researcher's interpretations and be protected from the researcher's bias (Lincoln & Guba, 1985). The study has attained interpretative validity (Eisenhart, 2006) if the persons whose sense-making is being studied accepts the researcher's interpretation of the meaning of the events. In other words, that the conclusions are correct and believable (Merriam, 1998).

In this study, the participants were given their case histories and transcripts back, along with an invitation to provide feedback on anything they believed did not adequately capture what was stated. This gave them the chance to clarify any points that might have been unclear by providing further information.

4.5.8 Peer Validation

With the goal of ensuring that the interpretations were not influenced by the researcher's requirements or personal prejudices, the researcher spoke with academic peers about the findings and how they were being interpreted. Also, the researcher had conversations with her supervisors' multiple times about her viewpoint, the data analysis, the coding and the conclusions to ensure that the interpretations she made were supported by the data (Merriam, 1998).

4.6 Data Collection and Research Tools

This section consists of the following sub-sections:

- Research Questions and Objectives
- Quantitative Data Collection Procedure
- Teachers' Sense of Efficacy Scale
- Qualitative Data Collection Procedure
- Observation Protocol
- Interview Protocol
- Observation of Teaching

4.6.1 Research Questions and Objectives

This research was carried out using a sequential explanatory design study, in which the quantitative data was collected first, followed by a qualitative investigation of a sub-sample of the participants to acquire a better understanding and to enhance the quantitative findings. Table 4-3 identifies the linkages between the research questions and objectives, in relation to the corresponding data sources and data analysis approaches.

Table 4-3. Links between research questions and data sources

Research Question	Objectives	Data Sources	Data Analysis
RQ1: Do Saudi final year PSTs have a sufficient level of knowledge, experience and self-efficacy to be classroom-ready to teach with technology?	Assess PST technological competencies	• PST observations • PST interviews • Self-efficacy Surveys	• Pre- and post-course completion self-efficacy scales • Qualitative data from observations and interviews • Reflective statements
RQ2: How do Saudi pre-service teachers adapt the use of technology in their classroom through participation in educational technology programme (ETP) and professional placement experience (PPE)?	Assessment of PST use of technology compared with final self-efficacy data Improve the positive factors influencing PST self-efficacy	• Pre- and post-self-efficacy Surveys • Observations • Interviews	• Quantitative data • Qualitative data
RQ3: Does PSTs self-efficacy change through the	Measure PST self-efficacy	• Observations • Interviews	• Qualitative data • Quantitative data

Research Question	Objectives	Data Sources	Data Analysis
participation in the course? If yes, what drives this change? If no, what are the potential reasons for this?		• Surveys before and after the course	

4.6.2 Quantitative Data Collection Procedure

Before beginning the Education Technology program, the pre-service teachers assessed their level of self-efficacy using a teachers' sense of efficacy test accessible via the Qualtrics survey link provided in their invitation email. The survey questionnaire items were then answered by respondents, which required an estimated 6-8 minutes to complete. However, respondents were given the option of suspending the survey and returning at a later time if that was more convenient for them. The Qualtrics software (https://www.qualtrics.com/au/) used to collect responses assigns a unique ID to each response, rather than recording the respondent, by the researcher selecting "Anonymize responses" in the survey options menu. This approach ensures data are collected and can be analysed without identifying participants.

4.6.3 Teachers' Sense of Efficacy Scale

A modified version of Tschannen-Moran and Woolfolk Hoy's (2001) Teachers' Sense of Efficacy Scale (TSES) was administered before and after the Education Technology program. A modified version was used, as four additional items relating to educational technology implementation were added (Saienko, Lavrysh, & Lukianenko, 2020) as shown in Appendix B. I have explicit permission from the website, as it offers free usage for everyone, as outlined in Appendix A. These questions related to Technology Integration were modified to fit with the research questions. This modified scale has been used in different cultural environments, including in Saudi Arabia, to measure the effectiveness of secondary school teachers in Riyadh after testing its reliability and coherence (Al-Kathiri, 2011).

The modified scale consisted of 16 items distributed on four factors, each containing four items: Efficacy in Student Engagement, Efficacy in Instructional Strategies, Efficacy in the Classroom Management and Efficacy in Technology Integration. The adapted version of the test combines the teacher's self-efficacy responses with the integration of technology (technological, pedagogical and content knowledge), which

relate to the aims of the current research, as illustrated by the following four question examples (see Appendix B):

- 4. How well can you integrate the instructional strategies with technology? to
- 4. How confident are you to integrate technology with instruction?
- 7. How much can you do to improve your technology skills? to
- 7. How well can you adopt and adapt technology to specific learning tasks?
- 11. How well do you select the technologies that you plan to use? to
- 11. How confident are you to create new ways to use technology in your teaching?
- 14. To what extent does technology impact your classroom management? to
- 14. How useful do you think technology is for enhancing your teaching?

Prior to commencing research using the questionnaire, a pilot study was done using a smaller sample size to test the suitability of the research questionnaire and the questions. Subsequently, some terms was modified for simplicity and appropriateness for the colloquial Arabic language which would be likely to be more easily understood by study participants. Of the 132 PSTs who participated in the study, 97 completed the questionnaire.

Because the Management and Efficacy in Technology Integration item had not yet been validated in the Saudi university education environment, an Exploratory Factor Analysis (EFA) were conducted only in this study and no Confirmatory Factor Analysis (CFA) as the study was designated to be the first investigative, only descriptive analyses were used as a kind of analysis while CFA cannot be involved due to investigative research nature. The internal reliability coefficient of Cronbach's alpha was determined, and McDonald's omega was calculated due to concerns about coefficient alpha underestimating true reliability in multi-item measurement scales (Hayes & Coutts,2020). The Teachers' Sense of Efficacy Scale was tested using SPSS software (see Sections 5.3 and 5.4).

4.6.4 Qualitative Data Collection Procedure

The implementation of the study involves conducting organized lessons with pre-service teachers according to the schedule outlined in Table 4-2. The primary objective was to elucidate the aims of the Education and Training Programme (ETP) while engaging in discussions related to integrating technology to enhance pedagogy and potentially improving access to content knowledge.

The decision to conduct remote lessons was necessitated by emergency changes due to the COVID-19 pandemic during the specified period (September through December 2021). This approach was also adopted to prepare for any unforeseen changes that could occur during the application period, such as the potential return to distance education. Face-to-face meetings were restricted to no more than 12 people by the Training and Scholarships Department during this period. To conduct the observations and interviews, Microsoft Teams was chosen as the platform for meetings with pre-service teachers, given their familiarity with the application.

Apart from the scheduled meetings, WhatsApp was employed to connect with pre-service teachers individually and within independent groups. Remote observation replaced physical visits to schools where female teachers taught, as they agreed to provide microteaching sessions online with their university supervisors.

Observations, in-depth interviews (IDI) and focus groups (FG) were used to collect qualitative data; however, these interactions were conducted online rather than face-to-face due to the risk of contracting the COVID-19 highly infectious Omicron variant, which was prevalent in the community during the study (WHO, 2021).

4.6.5 Observation Protocol

This study's observation protocol was designed to incorporate elements of the selected content, teaching strategies and technologies considered together. This approach was based on the instrument proposed by Harris, Grandgenett and Hofer (2010) to assess PST technology integration. These diverse learning activities showed how different technical tools may be utilised to accomplish certain goals. The micro-teaching types were regarded as a good guide for such observation because the goal of the observation was to determine how pre-service teachers use technology in various classrooms and subjects.

Statements pertaining to how instructors can employ technology in their courses were included in the observation procedure for this study. The following sentences were adapted and modified from the TPACK framework and SAMR model. The assumptions were standard, such as knowledge/skills of ICT technologies used in micro-teaching. Prior to observation, the PSTs lesson plan was obtained as a supplementary explanation and was shown the protocol for observation. See Appendix C for details.

4.6.6 Interview Protocol

Semi-structured interviews were one of the data collection approaches used in this investigation. Each interviewee in a semi-structured interview was asked the same set of questions. However, based on responses to the questions, the interviewer was allowed to ask additional questions (Creswell, 2009).

For this study, each PST who took part in the case study was asked a series of baseline questions and then follow-up questions were asked which differed somewhat depending on their prior replies. The interview questions were written keeping in mind the objectives of the interview, the topics to be covered and the additional parameters offered by Cohen, et al. (2007).

Draft questions were studied and critiqued by this study's Australian university supervisors and were modified according to feedback. The questions were then translated into Arabic. An educator on the faculty of Saudi University was given these questions to check to ensure they would be clear and intelligible to the Saudi students and comprehensive in light of the research issue the study was attempting to solve.

Some of the questions were modified from this feedback to ensure that all of the questions could be answered appropriately and that the questions were focused on the issues that PSTs were experiencing.

The interview questions were divided into thematic categories based on student self-efficacy, which were mastery experiences, emotional states/conditions, social persuasion/social support, teaching with technology and preparedness and competence for the future. The final questions, in English and Arabic, are detailed in Appendix D.

4.6.7 Observation of Teaching

Observation was employed in this study as it forms an important aspect of data gathering in ethnographic studies and enables a researcher to experience and record activities in the setting being studied, e.g., in integrating technology in pre-service teacher teaching (Laski, 2023). Thus, nine pre-service teachers who were respondents in the study consented to be observed in online micro-teaching classes on the Zoom video-conferencing platform (https://www.zoom-platform.com/about) to determine how they used technology and how they employed different technology tools in the different topics they taught.

The role taken by the researcher in this study was of non-participant observation, a technique used in conjunction with other data collection methods to gain a deeper understanding of situations that would not be captured without it (Liu & Maitlis, 2010). In this type of observation, the researcher plays the role of a spectator or viewer in relation to the phenomenon or event that is the subject of the research: the researcher looks or listens to a specific situation without participating in it.

4.6.8 Analysis Using the TPACK Framework

The Technological Pedagogical Content Knowledge (TPACK) framework was employed to analyze how pre-service teachers integrate technology into their teaching. This process involved several steps:

Lesson Plans: Pre-service teachers' lesson plans were reviewed to identify instances where technology was integrated into the content and pedagogy. Specific attention was given to how technology was used to enhance teaching strategies and content delivery. The lesson plans were coded for elements of TPACK, specifically focusing on technological knowledge (TK), pedagogical knowledge (PK), and content knowledge (CK), as well as their intersections (TPK, TCK, PCK, and TPACK).

Observations: Classroom observations were conducted using a structured protocol based on the TPACK framework and the SAMR model. Observers looked for evidence of how teachers utilized technology to transform learning experiences at different levels (Substitution, Augmentation, Modification, and Redefinition). Observational data were coded to identify patterns in the use of technology that aligned with the TPACK components.

Interviews: Interviews with pre-service teachers were conducted to gain insights into their experiences and perceptions regarding technology integration. The interviews were analysed to uncover themes related to their self-efficacy, challenges, and successes in using technology. Thematic analysis was used to connect these themes to the TPACK framework,

providing a deeper understanding of how technological, pedagogical, and content knowledge interacted in practice.

Data Integration: The data from lesson plans, observations, and interviews were triangulated to provide a comprehensive picture of how pre-service teachers adapted and integrated technology into their teaching. This triangulation helped to validate the findings and ensure that the analysis was grounded in multiple sources of evidence.

By using the TPACK framework, the study was able to systematically analyze how pre-service teachers' knowledge and skills in technology integration evolved through their participation in the educational technology programme (ETP) and professional placement experience (PPE). This approach provided a robust mechanism to link theoretical constructs with practical applications, ensuring that the analysis was both rigorous and relevant to real-world teaching contexts.

4.7 Quantitatve Data Analysis Procedures

To ensure accuracy in analyses of the data, only questionnaire responses that were completely filled out were included in the Qualtrics-based survey, which resulted in the removal of incomplete or partially completed surveys with data missing at random. However, to ensure the existing data were captured and utilised in the study, these questionnaires were subsequently transferred from Qualtrics to online Excel and finally to SPSS version 19 for analysis.

Typically, some respondents in a survey may make errors or fail to answer some parts of a questionnaire, which requires the researcher to adopt multiple methods of recording analysis that enable all data to be incorporated in the study results without loss of statistical precision and power. See Section 5.2.3 for further details.

4.8 Reliability and Validity of the Self-efficacy Survey

Tool validation is one of the primary methodological procedures aimed at ensuring that the content of the instrument used in the study is appropriate for the objective collected for its measurement.

For the purpose of validating the data efficiency level measure for the use of technology in teaching, the study used Face validity.

Face validity refers to the principle that the questions, from the perspective of the respondents, measure what they are supposed to measure (Bandalos, 2018). To achieve face validity, the questionnaire in its initial form was presented to three arbitrators from the faculty from the selected university who specialise in curricula and teaching methods. They were asked to express their opinions on the wording of the questionnaire in terms of the validity of the content to measure what was presented and the clarity of the phrases and the suitability of each phrase to the field to which it belongs. In addition, they were invited to modify or delete the wording of the phrases or add a new phrase to the study tool as well as expressing their opinions on the questionnaire and its overall clarity.

Based on the expert advice of the arbitrators, amendments were made to the questionnaire which further improved its validity, measurability and relevance to the field of study.

4.9 Quantitative Data Analysis

This section contains the following sub-sections:

- Thematic Analysis
- Paired Sample T-test Analysis
- Multiple Linear Regression Analysis

4.9.1 Thematic Analysis

To investigate and analyse the quantitative data associated with the open-ended questions, a thematic analysis using coding was conducted. This approach included familiarising with the data sets, basic coding and theme outline, as well as evaluation and adjustments (Silverman, 2011). The data were coded and entered into the SPSS program and shortcuts were created for all 16 items of the questionnaire questions. Table 4-4 shows the questions and their shortcuts.

Table 4-4. Questions and shortcuts

Item	Question	Shortcut
1	How much can you do to control behaviour in the classroom?	Behaviour Control in the Classroom
2	How much can you do to motivate students who show low interest?	Motivating Students with Low Interest

Item	Question	Shortcut
3	How much can you do to get students to believe they can do well in studying?	Building Student Confidence in Academic Success
4	How confident are you to integrate technology with instruction?	Integrating Technology with Instruction
5	How much can you do to help your students value learning?	Instilling Value for Learning
6	To what extent can you craft good questions for your students?	Crafting Effective Questions for Students
7	How well can you adopt and adapt technology to specific learning tasks?	Adapting Technology to Learning Tasks
8	How much can you do to get students to follow classroom rules?	Enforcing Classroom Rules
9	How much can you do to calm a student who is disruptive?	Calming Disruptive Students
10	How well can you establish a classroom management system with each group of students?	Establishing Classroom Management Systems
11	How confident are you to create new ways to use technology in your teaching?	Creating Innovative Technology Use
12	How much can you use a variety of assessment strategies?	Utilizing Assessment Strategies
13	To what extent can you provide an alternative explanation or example when students are confused?	Providing Alternative Explanations
14	How useful do you think technology is for enhancing your teaching?	Perceiving Technology's Role in Teaching Enhancement
15	How much can you do to get students to work together?	Encouraging Student Collaboration
16	How well can you implement alternative strategies in your classroom?	Implementing Alternative Strategies

4.9.2 Paired Sample T-test Analysis

A paired sample t-test analysis was conducted (see Section 5.5.3) to compare PST self-efficacy before and after the course and once they have had practice in applying ICT to different contexts. A sample t-test analysis is used to compare paired outcomes for the same sample or category twice (Thompson, 1998), in this case, the PST self-efficacy scores in the pre- and post-studies.

4.10 Qualitative Data Analysis

This section contains the following sub-sections:

- Analysis using Quirkos Software
- Quality and Validity of Qualitative Results
- Data Verification

4.10.1 Analysis using Quirkos Software

In order to facilitate the analysis process, the Quirkos software was utilized to store and visually explore the data. Data was collected and analysed in Arabic and then translated into English. Native speakers reviewed the Arabic and English transcripts for accuracy to ensure data reliability and the generation and translation of themes. In Quirkos, the Arabic-English transcript was created so that both supervisors and researchers could review it at the same time. The different themes and patterns that emerged from students' responses are shown in Figure 4-3.

Figure 4-3. Themes and patterns revealed by Quirkos software.

4.10.2 Quality and Validity of Qualitative Results

To enhance the quality and validity of the qualitative findings, researchers and scholars sought to establish specific criteria to ensure the accuracy of their results (Lincoln & Guba, 1985). In this study, multiple data sources (triangulation), including sustained engagement, ongoing observation, triangulation of data sources and peer

researcher triangulation, were used to achieve credibility (Lincoln & Guba, 1985). Thematic analysis was employed to analyse interviews, observations and documents, such as teaching resources and online course materials. Thematic analysis is a methodology used to define, evaluate and report themes within the data to ensure reliability (Braun & Clarke, 2013).

4.10.3 Data Verification

Data verification is reliant on thorough theme analysis, (Braun & Clarke, 2006). For thematic analysis to be accurate and reliable, this verification process must align with sound principles. It is particularly appropriate for producing work that is based on practice (Peel, 2020).

The first step was to translate the voice data into written text and thoroughly examine it. A translation from Arabic to English was also performed to facilitate the analysis of the data. To increase the accuracy of the analysis, the researcher generated initial codes on the data and discussed them with supervisors and critical colleagues, identifying themes.

The next step involved assembling the codes into potential themes, closely related to the framework and theories. In order to ensure that the potential themes captured the essence of the data and were not biased by the researcher's perspective, potential themes were reviewed with supervisors. An overall thematic map was created to visualize the relationship between the themes and data. The researcher defined and named each theme clearly and concisely, ensuring they were easy to understand and conveyed the core message of the research.

A final step was to produce the report, referring back to the original research questions. An organized and logical approach was taken to present the themes and their relationship to the research questions in the report.

4.11 Ethical Considerations

Ethical approval from the Social and Behavioural Research Ethics Committee of Flinders University (Approval No. 4096) was obtained prior to collecting data (see Appendix A).

Participants were informed of the purpose and aims of the research using the Introduction and Information Sheet, before they were asked to sign the Consent Form

(Appendix F). Although the identity of participants was kept confidential, it was explained that some responses would not be anonymous to enable tracing of participant responses back to individuals to enable pre- and post-data matching. However, the identification would be deleted upon matching to maintain confidentiality.

Participants were informed that their confidentiality and anonymity would be protected, and they had the right not to participate in the study and to withdraw at any time without any consequences to their academic studies.

After getting approval, approval, I communicated with the Dean of the College of selected university requesting formal permission to conduct this research and requesting faculty assistance to facilitate the tasks involved in the research.

Once approval from selected university was obtained, my request was sent to the Field Education Supervisor, who in turn sent the introduction letter and an information sheet (see Appendix F) to all pre-service teachers by email to invite them to participate in the study by completing questionnaires and involvement in subsequent observations and interviews. The invitation, including the information sheet and consent form, emphasised that student participation in the study was entirely voluntary with no obligation to be involved.

The salutation, “Dear Pre-service teacher” and the accompanying letter were written in a personal, friendly tone aimed at establishing an informal and reassuring relationship with potential participants. As the primary researcher, my name and Australian university affiliation were included in the email, as well as a description of the purpose of the survey and expected response time from participants. Although the first page of the survey asked for their written consent and personal identification, teachers were guaranteed anonymity and confidentiality of the information they provided. This was done to reassure instructors that student replies would be kept private before they clicked on the survey link and began to complete the form electronically. To show appreciation for their time in advance, a thank you message was appended to the email.

Although I previously taught at the institution where the study was conducted, I did not have any teaching responsibilities during the study period. The ethical approval process ensured that participant recruitment and engagement were conducted

impartially, without influence from my prior teaching role. Students were recruited via an email invitation from the Field Education Supervisor, and engaged through voluntary participation in questionnaires, observations, and interviews, while maintaining clear communication and professional boundaries between the researcher, students, and reviewers throughout the process.

4.12 Chapter Summary

In this chapter, the research paradigm, design, approach, data collection methods, data analysis procedures, validation studies, validity issues and ethical considerations of the study are discussed. To answer the study's research questions and achieve its objectives, a mixed-methods approach and an explanatory sequential design are used. Confirming, interpreting and justifying the quantitative data collection is done through semi-structured interviews, observation and focus groups. By adding a qualitative component to the study, the quantitative results are supplemented and enhanced, resulting in a deeper understanding of the research questions.

The research journey begins to take shape in the following chapters as we explore the unique domains of quantitative and qualitative analyses. Taking the research paradigm, design and mixed-methods approach that have been laid bare in this chapter – as a foundation to build upon, the succeeding chapter elaborates on quantitative results methodically. What follows is this numerical exploration, complemented and contextualized by the following qualitative chapter where we dig into richness of data through semi-structured interviews, observation and focus groups. Together, the series of sequential chapters presents a complete and balanced approach to exploring research questions, presenting both qualitative insights and quantitative rigor.

5. Quantitative Result

This chapter contains the following sections:

- Introduction
- Context of the Main Study
- Validity of the Study
- Analysis of Reliability of the Study
- Presenting Results
- Results for Individual Teachers
- Chapter summary

5.1 Introduction

In this chapter, I will begin by conducting a literature review of the related studies which shall serve as a basis for further discussion on the instrument used to evaluate teacher self-efficacy. This instrument is the Teachers' Sense of Efficacy Scale (TSES) (Tschannen-Moran and Woolfolk Hoy, 2001) (see Section 3.5). To explain my factor analysis within the TSES paradigm, I will lay a foundation first. To this end, by examining such factors including classroom management, student engagement, instruction strategies and the new factor of technology integration in the TSES instrument.

The TSES is an excellent scale of measuring this construct since it examines the efficacy perception in three domains that include student engagement, instructional strategy and classroom management. The research aims to advance the knowledge of self-efficacy by establishing a link between the construct and pre-service teachers, considering technological tools as one means of achieving educational results.

The adaptation of the TSES for this study addresses the critical need to assess teachers' self-efficacy specifically in technology integration, a facet not comprehensively covered by the original scale. While the TSES primarily focuses on general teaching self-efficacy, the inclusion of additional questions pertaining to technology use allows for a nuanced exploration of educators' confidence and

readiness in integrating technology into their instructional practices. Despite the recent development of these supplementary questions in 2020, their inclusion was guided by the necessity to fill a research gap identified in the literature. While acknowledging the need for further validation questions, I justify their adoption based on preliminary assessments in diverse educational contexts, including Saudi Arabia, indicating initial reliability and relevance. This approach not only expands the scope of the TSES but also responds directly to the research questions regarding teachers' efficacy perceptions in technology integration, contributing to the broader discourse on effective educational practices in contemporary settings.

The adaptation of the TSES used in this study aimed to assess teachers' readiness, including their self-efficacy in incorporating technology into teaching practices. While the original TSES framework primarily focuses on broader self-efficacy in teaching, the adaptation includes specific items related to technology integration. These additional items were chosen to capture nuances in teachers' perceptions of their preparedness specifically regarding technology use, aligning with the study's focus on evaluating preservice teachers' readiness in this context. Although the scale used in this study derives from Saienko et al. (2020) and incorporates modifications from the original TSES by Tschannen-Moran and Woolfolk Hoy (2001), it is essential to clarify that the adapted version was selected based on its relevance to the study's objectives and its alignment with prior research on technology integration in education. Future revisions will explicitly specify the scale's adaptations and their implications for validity, ensuring transparency and coherence in the methodological approach. This approach ensures that the study effectively measures the targeted constructs while contributing to the ongoing discourse on educational efficacy and technology integration.

The quantitative data analyses of the modified version of the Tschannen-Moran and Woolfolk Hoy (2001) Teachers' Sense of Efficacy Scale (TSES) are presented. (A literature background for the TSES is contained in Section 3.5.) The TSES scale was utilized to gauge the influence of lessons on pre-service teachers perceived self-efficacy in meaningfully implementing technology. Specifically designed to measure changes before and after exposure to the TPACK framework and the SAMR model (Duffin et al., 2012), this instrument served as a critical tool for assessing the

readiness of pre-service teachers to incorporate technology in their teaching practices. Adaptation of the TSES for this study is described in Section 4.6.3.

The results of the current study not only indicated cultural influences on effectiveness measures, but also compared 24-item and 12-item versions that favoured a more parsimonious preferred nine items version with improved factors loadings as well as reliabilities. These cultural transitions facilitate the body of knowledge on TSES versatility and resilience in detecting teacher self-efficacy among a variety of culturally diverse educational settings.

The chapter unfolds with a presentation of the Factor Analysis data, providing a comprehensive understanding of the underlying constructs and dimensions measured by the instrument. Subsequently, the focus shifts to the assessment of reliability through Cronbach's Alpha, ensuring the consistency of the instrument's measurements. Confidence intervals are then presented, adding a layer of statistical robustness to the results.

Integral to this investigation is the response to the pivotal research question (RQ1): "Do PSTs perceive they have sufficient levels of knowledge, experience and self-efficacy to be classroom-ready to teach with technology?" The (sufficient knowledge and experience) refers to the level of skills and confidence that educators possess to effectively utilize technology within the classroom setting. This encompasses not only their familiarity with technological tools but also their ability to integrate these tools into their teaching practices to enhance learning outcomes. This was measured through a combination of survey questions designed to assess educators' self-reported proficiency and comfort with technology, as well as through observed teaching sessions where the practical application of technology was evaluated. The survey questions focused on specific competencies, while the observations provided real-world evidence of their ability to incorporate technology into instructional activities.

The analysis and interpretation of the quantitative data are intricately linked to addressing this research question, shedding light on the technological preparedness and self-efficacy perceptions of pre-service teachers.

In addition to its immediate findings, this study makes an important contribution to the general level of educational methodology studies. The use of psychometric analyses on the tool in the specific environment of Saudi Arabia brings a peculiar

facet to what has been explored so far. The study provides useful insights into the cross-cultural validity and reliability of instruments by systematically investigating this cultural and educational context. This contribution not only enhances the methodological standards of the research but also provides a path for future studies that aim to validate instruments in other environments. Finally, the inclusion of psychometric analyses contributes to a growing body literature on adaptability and provides insight into factors underpinning research outcomes in worldwide contexts.

5.2 Context of the Main Study

This section contains the following sub-sections:

- TSE Survey Respondents
- Responses to the Survey
- Handling Missing Data
- Psychometric Investigation Results

5.2.1 TSE Survey Respondents

The prerequisite for this field placement course was that the student must pass all the previous courses of the ET programme successfully. Pre-service teachers were then allocated a field placement position according to the need in the region and based on their specialisations., They were often sent to the intermediate and secondary levels because the distribution of female students to schools is determined by the regional education department authorities. and they often distribute pre-service teachers according to the need and deficit of the schools. However, pre-service Kindergarten teachers were only sent to kindergarten and pre-school education sites.

All participants in this study were final year, final semester Saudi pre-service teachers from the College of Arts and Sciences. They were aged between 21 and 23 years and spoke Arabic as their first language.

5.2.2 Responses to the Survey

Table 5-1 shows the number of respondents in the pre- (Time 1) and post-test (Time 2) according to the area of specialisation.

Table 5-1. Survey respondents and specialisations

Specialisation	Time 1	Time 2
Islamic Studies	30	14
English as a Foreign Language	19	9
Not identified	19	15
Mathematics	11	2
Arabic	8	6
Science	5	2
Kindergarten Studies	3	1
Computer Science	2	3
Total	**97**	**52**

Initially, 147 pre-service teachers started the survey, representing 66% of the intended participants. However, 50 of them did not complete the survey, leaving 97 participants at time 1. Subsequently, a follow-up post-questionnaire was sent exclusively to the same group of 97 participants. In time 2, only 52 participants responded and out of those, only 12 pre-service teachers provided data that matched their responses from time 1. The flowchart in Figure 5-1 visually represents this process.

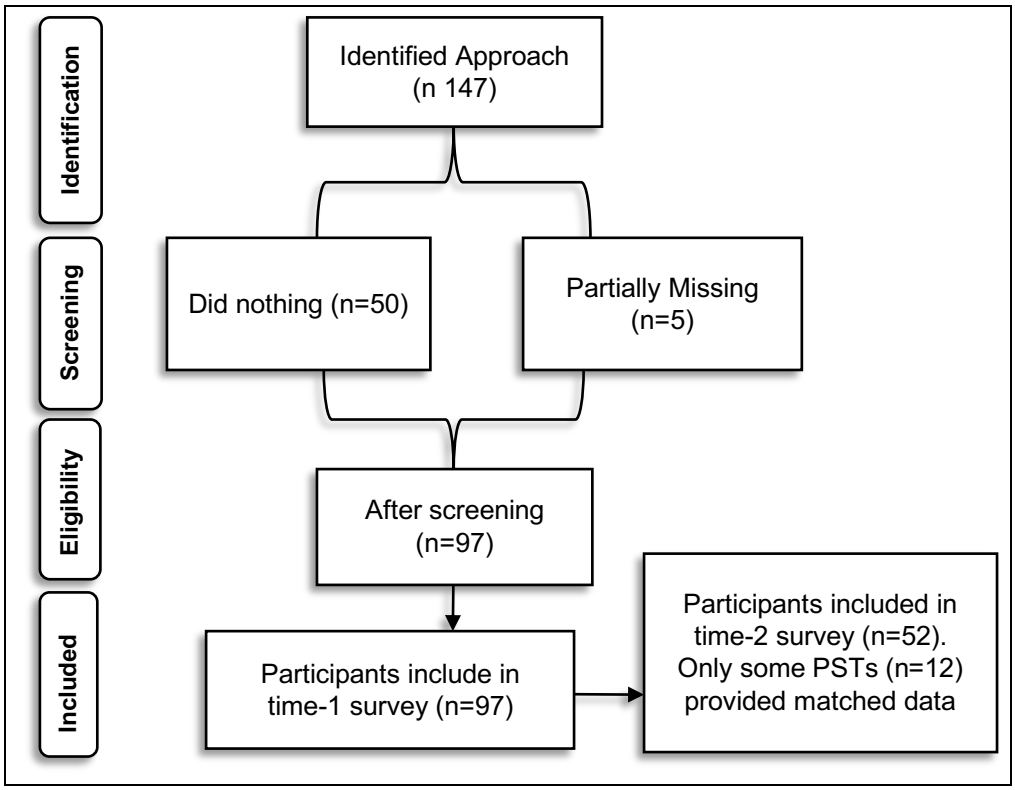

Figure 5-1. Participation in the quantitative study

5.2.3 Handling Missing Data

Five participants had missing values in the pre-questionnaire. The challenge of managing missing data is a common problem in any survey or questionnaire-based research project, since respondents will often fail to complete or answer all the items in a survey (Miao et al., 2018). How the missing data is considered and factored into analyses of results is therefore of considerable importance (Rubin & Little, 2019; Van Ginkel et al., 2020).

Kongsved et al. (2007) found that response rates to Internet-based questionnaires were considerably less in comparison to traditional methods of collecting data from potential respondents in personal or phone interviews. Other researchers (for example, Daikeler et al., 2020; Fincham, 2008; Voorpostel et al., 2021) have remarked on the difficulty of achieving high response rates using online surveys and have suggested that reaching 60% rate of return might be advisable to establish validity and reliability and reduce the effects of non-response bias. The response rate for this study was similar to that experienced in previous educational technology research in Saudi Arabia which used similar questionnaires to those in this study (Al-Marwani, 2016). Given these considerations, the pre-test and post-test response rate for this research of 78.86% and 56.5% respectively is regarded as satisfactory and compares well with another research in Saudi Arabia (Alharbi, 2020; Al-Subaihi, 2008).

In addressing the challenge of missing data in a small dataset comprising only 5 participants, a pragmatic approach was essential. Although initially considering complex methods such as multiple imputation, their application in such a small dataset could lead to complications and overfitting (Schafer & Olsen, 1998). Therefore, careful consideration led to the use of the single imputation technique of Expectation-Maximization (EM). This straightforward and computationally efficient procedure determines missing values based on existing information and is particularly suitable for datasets with fewer missing values (Nelwamondo et al., 2007). The missing data was minimal, with only five values, and was addressed using the expectation maximization method.

The decline in response rate from the pre-survey to the post-survey suggests that PSTs were less motivated or less inclined to continue their participation in the research after completing the Educational Technology Course at the selected university than they

were before the course began. The differences in response rates may have been influenced by a number of factors such inconvenience of participating in interviews and focus group discussions via an Internet platform (Sammut et al., 2021) and the external academic pressures experienced by PSTs during the end-of-studies academic activities in their final semester. In particular, the necessity of interacting with students electronically during the data collection period, rather than conducting face-to-face sessions, could be seen as a compelling reason for difficulty in persuading students to participate. During this phase of the research (October 2021) the effect of COVID-19 restrictions reduced opportunities for the researcher to meet directly with participants or to hold focus group sessions. Thus, all interactions were conducted on the Qualtrics platform. These challenges required some adjustment and modification to methods and may have influenced the level of engagement of the participants.

5.2.4 Psychometric Investigation Results

The decision to undertake extensive psychometric analyses on the instrument, despite its prior validation by the original developers, was grounded in the acknowledgment of the distinct Saudi Arabian context in which it was employed. The rationale stems from the understanding that cultural, contextual and population variations can significantly impact the psychometric properties of an instrument (McKechnie, Fisher et al, 2020). Instruments validated in one setting may not seamlessly translate to another, particularly in the realm of education, where factors such as cultural nuances, language differences and educational practices play crucial roles. By conducting these analyses in the Saudi Arabian context, the study aims to ascertain the instrument's reliability and validity for the specific population, ensuring that it effectively measures the constructs of interest within the unique educational landscape of Saudi Arabia. Additionally, this approach aligns with the need for cross-cultural adaptation and acknowledges the practical relevance of validating the instrument within the specific cultural and educational milieu, enhancing the credibility and applicability of the study's findings.

A fourth factor proposed by Saienko, Lavrysh and Lukianenko (2020) was added to the Teachers' Sense of Efficacy Scale (TSES), originally developed by Tschannen-Moran and Woolfolk Hoy (2001) to be used in this study (Section 3.5.6). The first factor is efficacy in instructional strategies, which is the teacher's assessment of their capacity to create different strategies based on the needs of the class, reply to

questions from students in a suitable manner and offer challenging enough material for the most advantaged students while also considering the proper evaluation of the material covered, all in an effort to support their students' optimal performance. The second, known as Efficacy in Classroom Management, is a component that helps to explain how confident a teacher feels in influencing students to follow classroom regulations while promoting emotional and behavioural control to ensure that every student learns. The third factor, Efficacy in Student Engagement, measures how well a teacher can help students improve their assignments, demonstrate self-assurance and value their own skills (Tschannen-Moran and Woolfolk Hoy, 2001). The new fourth factor, Efficacy in technology integration, refers to a teacher's perceived capacity to integrate instructional strategies with technology and confidence in adopting and adapting new technologies to improve classroom management (Saienko, Lavrysh and Lukianenko, 2020).

In analysing responses from the 97 participants, the perceived influence of items (item 1 to item 16) was assessed using a 9-point scale ranging from 'nothing' to 'a great deal,' with higher scores indicating a greater perceived impact. The mean values for each factor ranged from 5.39 to 6.92. Notably, items 14 and 15 had mean values of 6.92 and 6.87, respectively, suggesting a significant influence. Meanwhile, items 2, 3 and 6 exhibited mean values around 6.26 to 6.80, indicating a moderate yet discernible influence.

These findings provide valuable insights into the perceived impact of these factors, with a mean of 6 generally representing a level of influence falling between "some influence" and "quite a bit." The accompanying row percentages and counts further detail the distribution of responses, contributing to a comprehensive understanding of participant perspectives on the measured variables. For detailed statistics, please refer to Appendix E, in which the mean values, row percentages and counts for each factor are presented individually.

5.3 Validity of the Study

This section contains the following sub-sections:

- Sample Size and Subject-to-Item Ratio
- Applicability to Saudi Context

- Validity of the TSES
- Principal Axis Factoring
- Explained Variance
- Rotated Factor Matrix
- Exploratory Factor Analysis and Selection of Solution
- Definition of Factors

5.3.1 Sample Size and Subject-to-Item Ratio

The size of the sample and the acceptable subject-to-item ratio must also be determined by the researcher. To achieve a stable factor structure, this is an important component to take into account. Regarding the appropriate subject-to-variable ratio or sample size, there is no general agreement. One often mentioned guideline is to have at least 200 participants overall and 5 participants for each variable (Norris & Lecavalier, 2010).

There is debate amongst researchers regarding the criterion required to be met for the size of the participant sample of instances compared to the number of variables used in factor analysis (Mundfrom et al., 2005; Wolf et al., 2013; Yong & Pearce, 2013). For example, research by Zeller (2006) revealed that two dimensions and 20 variables may be precisely measured with a sample size between 10 and 50. In separate research, Preacher and MacCallum (2002) identified that with a sample size of 10, it was feasible to obtain accurate findings when evaluating two variables with communalities (the strength with which two variables are associated) between 0.8 and 0.9. The Teachers Sense of Efficacy Scale survey method used in this study suggests that five instances are sufficient to assess the factor validity, reliability and assessment with the sample size of n=97 per 16 items (Fives & Buehl, 2009; Ngidi & Ngidi, 2019; Poulou et al., 2019).

5.3.2 Applicability to Saudi Context

An examination was conducted to assess consensus on the items, phrasing and applicability of the scale within the Saudi context, aligned with objectives of the current research. The average agreement percentage on their suitability reached 80%, except for specific items 4, 7, 11 and 14 (see Appendix B). Adjustments were made to

enhance their appropriateness based on insights from two professors. The experts unanimously agreed that the instrument's questions did not result in misunderstandings but recommended reconsidering specific terms in these aforementioned items to avoid potential misinterpretations. The wording underwent scrutiny, particularly focusing on terms that might pose confusion within the Saudi context.

An instrument understanding was validated (pilot) by 20 female students at the selected university in south of Saudi Arabia. The survey was conducted using Qualtrics Forms and it was completed within 10 minutes with no difficulties. There were 16 items in the instrument.

5.3.4 Validity of the TSES

Despite all employed instruments being validated through previous research, an exploratory factor analysis was conducted to test their construct validity in this study.

As Tschannen-Moran and Woolfolk Hoy (2001) pointed out, performing a factor analysis for pre-service teachers is necessary since the structure of factors in this population is less. Moreover, factor analysis assists in establishing how the participants responded to the questions, since the composition of the scales can vary slightly between factors. Using the current data set, exploratory factor analysis was conducted on four factors: Efficacy in Student Engagement, Efficacy in Instructional Strategies, Efficacy in Classroom Management and Efficacy in Technology Integration.

5.3.5 Principal Axis Factoring

The overall principal component extraction model assumes all variance to be shared so that communalities are equal for each variable (Kaiser, 1970; Glorfeld, 1995). This means zero specific variation in the model. But with reducing the number of factors, specific variance appears. In the principal axis factoring technique, an initial assumption of commonly shared variance is set so that communalities can be less than 1 (Glorfeld, 1995). This preliminary estimate is based on an assumption that the communality of each variable in this case equals the squared multiple regression coefficient of every other variable versus it. The principal axis factoring method is carried out by replacing the main diagonal of correlation matrix originally consisting

solely of items with these initial communalities (Glorfeld, 1995). Secondly, this modified correlation matrix is used to calculate the principal component.

In this study, a principal component analysis with varimax rotations was used to provide an explanatory factor analysis for the pre-test administered to pre-service instructors. With a KMO value of 0.836, much over the recommended cut-off of 0.6 (Kaiser 1970; Kaiser 1974), the data were suitable for factor analysis and Bartlett's Test of Sphericity (Bartlett 1954) reached statistical significance.

These results are presented in Table 5-2 and indicate the significance of Bartlett's Test of Sphericity, suggesting the factor analysis was appropriate. The Teacher Sense of Efficacy Scale (TSES) for teachers produced four factors, according to the results of the factor analysis. No load value for a 16-item set was less than 30, while 16 items were subjected to factor analysis, which produced a four-component structure (Cocca & Cocca, 2022).

Table 5-2. Results of KMO and Bartlett's Test

Test		Value
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.836
Bartlett's Test of Sphericity	Approx. Chi-Square	343.546
	df	55
	Significance	<.001

5.3.6 Explained Variance

Explained variance, also known as explained variation, quantifies the portion of the model's total variance that is accounted for by factors present within the model and is not attributable to error variance. It serves as a measure of the disparity between the model and actual data. Higher percentages of explained variance indicate a stronger strength of association, which also assists in making better predictions (Rosenthal & Rosenthal, 2011).

The results presented in Table 5-3 reveal that all four factors have eigenvalues exceeding 1, indicating their significance. As such, the researcher focused on three primary factors, which collectively accounted for 61.89% of the variance explained.

Table 5-3. Total variance explained

Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings	
Factor	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	4.353	39.571	39.571	3.863	35.115	35.115	3.076
2	1.333	12.117	51.688	.796	7.239	42.354	1.897
3	1.123	10.209	61.897	.618	5.618	47.971	2.708
4	.820	7.454	69.350				
5	.730	6.640	75.990				
6	.626	5.693	81.684				
7	.528	4.802	86.486				
8	.435	3.951	90.436				
9	.417	3.791	94.227				
10	.344	3.131	97.358				
11	.291	2.642	100.000				

Note: When factors are correlated for “Rotation Sums of Squared Loadings”, sums of squared loadings cannot be added to obtain a total variance.

5.3.7 Rotated Factor Matrix

Table 5-4 shows the Rotated Factor loadings, which illustrate the weighting of variables based on factors and reflect correlations between variables and constituent elements. These are correlation coefficients whose range of potential values is between -1 and +1. The option blank (.30) is used in the format subcommand, instructing SPSS to skip any correlations equal or lower than .3. Such a decision makes the output clearer by eliminating those low correlations which are most likely not to have any significant meaning. Scale refinement, guided by factor loadings in the analysis, led to the consolidation of variables for more coherent interpretation.

5.3.8 Exploratory Factor Analysis and Selection of Solution

In the initial phase of our Exploratory Factor Analysis (EFA), we examined potential solutions through a pattern matrix (Table 5-4).

Table 5-4. Pattern matrix

	Factor		
Question	1	2	3
Building Student Confidence in Academic Success			.577
Instilling Value for Learning			.724
Encouraging Student Collaboration	.577		

Utilizing Assessment Strategies	.641		
Implementing Alternative Strategies	.816		
Behaviour Control in the Classroom			.500
Calming Disruptive Students			.461
Establishing Classroom Management Systems	.570		
Integrating Technology with Instruction		.647	
Adapting Technology to Learning Tasks		.657	
Perceiving Technology's Role in Teaching Enhancement	.322	.425	

The extraction method used was Principal Axis Factoring and the rotation method Oblimin with Kaiser Normalization. The rotation converged in eight iterations.

Each solution held promise, yet upon closer scrutiny, the presence of cross-loading issues became evident, rendering them less suitable for this study. It is essential to understand the rationale behind not selecting these solutions, primarily due to the adverse effects of cross-loading, in which an item exhibits significant loadings on multiple factors, complicating interpretation of factor structures. In our case, four solutions were discarded because of cross-loading concerns. These solutions lacked the clarity and specificity required for a robust factor analysis outcome.

In Table 5-5, factor loadings before rotation shed light on the intricate relationships among efficacy factors related to student engagement, instructional strategies, classroom management and technology integration.

Table 5-5. Factor loadings before rotation

Factor	Code	Items	Before Rotation
Efficacy in Student Engagement	SE	2, 3, 5, 15	4
Efficacy in Instructional Strategies	IS	6, 12, 13, 16	4
Efficacy in Classroom Management	CM	1, 8, 9, 10	4
Efficacy in Technology Integration	TI	4, 7, 11, 14	4
Total			16

Following a rigorous evaluation, a strategic decision was made to refine the factor structure by excluding the following items:

- Motivating Students with Low Interest
- Crafting Effective Questions for Students

- Enforcing Classroom Rules
- Creating Innovative Technology Use
- Providing Alternative Explanations

These exclusions were prompted by observed cross-loading issues, with items 2, 8, 11 and 13 displaying such concerns and item 6 falling below the recommended loading threshold of 0.30.

The proposed solution, detailed in Table 5-6, strategically comprises the remaining eleven items, meticulously chosen based on their robust factor loadings.

Table 5-6. Factor loadings after rotation

Factors	Code	Items	After Rotation
Efficacy in Student Engagement and Classroom Management	SE, CM	1,3,5,9	4
Efficacy in Instructional Strategies	IS	10,12,15,16	4
Efficacy in Technology Integration	TI	4, 7, 14	3
Total			11

A description of the factor solution is outlined in Section 5.3.9.

5.3.9 Definition of Factors

The factors arising from the analysis in Section 5.3.8 (Table 5-6) are:

- Efficacy in classroom management and student engagement (F1_ECMSE).
- Efficacy in instructional strategies (F2_EIS).
- Efficacy in technology integration (F3_ETE).

These factors are further defined in this section.

The rationale behind this selection lies in the identified cross-loading tendencies and weaker factor loadings, which, when addressed through item elimination, resulted in a more robust factor analysis, as reflected in Table 5-4. This refinement not only upholds the integrity of the selected factors but also aligns with the overarching goal of streamlining the assessment instrument for a more precise evaluation of efficacy in various educational domains.

In summary, our commitment to methodological rigor led us to discard solutions with cross-loading concerns and, subsequently, refine our factor structure by omitting

specific items. This strategic approach has resulted in a more resilient and focused solution.

Factor 1 – Efficacy in Classroom Management and Engagement

This factor consists of the following items:

1 Behaviour control in the classroom.

3 Building student confidence in academic success.

5 Instilling value for learning.

9 Calming disruptive students.

The coherence of these items is theoretically grounded in their contribution to effective student engagement and classroom management. Marzano and Marzano (2003) emphasized the pivotal role of classroom leadership and strategic engagement strategies in optimizing student learning outcomes.

Factor 2 – Efficacy in Instructional Strategies

This factor consists of the following items:

10 Establishing classroom management systems.

12 Utilizing assessment strategies.

15 Encouraging student collaboration.

16 Implementing alternative strategies.

This grouping aligns with the theoretical construct of enhancing instructional strategies and fostering a positive classroom environment. Existing literature on teacher efficacy (for example, Tschannen-Moran & Woolfolk Hoy, 2001) underscored the interconnectedness of these aspects, highlighting how teacher confidence in instructional strategies contributes to a conducive and effective learning atmosphere.

Factor 3 – Efficacy in Technology Integration

This factor consists of the following items:

4 Integrating technology with instruction.

7 Adapting technologies to learning tasks.

14 Perceiving technology's roles in teaching enhancement.

The rationale behind this grouping is theoretically supported by literature emphasizing the importance of pre-service teachers' efficacy in integrating technology seamlessly into instructional practices. Researchers such as Mishra and Koehler (2006) have extensively discussed the theoretical framework of Technological Pedagogical Content Knowledge (TPACK), reinforcing the idea that effective technology integration requires a nuanced understanding of pedagogy, content and technology.

5.4 Analysis of Reliability of Study

This section consists of the following sub-sections:

- Introduction
- Analysis of Factor 1 ECMSE
- Analysis of Factor 2 EIS
- Analysis of Factor 3 ETE

5.4.1 Introduction

In the field of questionnaire design consistency is a basic criterion for evaluating reliability in relation to an instrument. This assessment becomes more important when the case involves questions designed with strict ordinal-scale responses where uniformity of participant's replies is crucial.

The basis of reliability assessment involves the use of Cronbach alpha value – a measure that estimates internal consistency across variable items. A major condition, as proposed by Hills (2008), is that each item's Cronbach alpha coefficient should be greater than 0.7 to consider the measure reliable. In order to overcome issues related to possible overestimation of actual reliability in multi-item measurement scales, the internal consistency coefficient Cronbach's alpha was used as a method based on Hayes and Coutts (2020), along with McDonald's omega calculation. The use of this dual-method approach helps in conducting an extensive and comprehensive test for the instrument's reliability, which enhances the credibility and validity of the questionnaire used in this research. Results are presented in Sections 5.4.2, 5.4.3 and 5.4.4. The factors are as follows:

- Factor 1 – Efficacy in Classroom Management and Student Engagement

- Factor 2 – Efficacy in Instructional Strategies.
- Factor 3 – Efficacy in Technology Integration.

In essence, the collective contribution of these findings to a comprehensive understanding of reliability across three factors inherent in this measurement instrument. The stability, robustness and internal coherence described through Cronbach's Alpha, McDonald's Omega and Intraclass Correlation Coefficients (see Sections 5.4.2, 5.4.3 and 5.4.4) are indicators of the instrument potential to consistently measure its targeted construct with accuracy alluding it as credible for research.

5.4.2 Analysis of Factor 1

In the reliability analysis of Factor 1 (Efficacy in Classroom Management and Engagement) which included items 1 (building student confidence in academic success), items 2 (instilling value for learning), items 3 (behaviour control in the classroom) and items 4 (calming disruptive Students) statistical tests were conducted using pre-test data (see Tables 12, 13 and 14). Cronbach's Alpha for the full scale yielded a satisfactory result of 0.640, indicating acceptable internal consistency. Additionally, the 95% Confidence Interval for Cronbach's Alpha, computed as 0.519-0.687, enhances the reliability of the assessment, implying a high degree of precision in the estimate. Furthermore, McDonald's Omega values, another measure of reliability, were considered. Building Student Confidence in Academic Success exhibited an Omega value of 0.640, Instilling Value for Learning had an Omega of 0.613 and Behaviour Control in the Classroom had an Omega of 0.689.

Table 5-7 presents data on item-scale mean, variance if the item is deleted, corrected item-total correlation and Cronbach's Alpha if the item is deleted.

Table 5-7. Factor 1 item-total statistics (pre-test)

Item	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Building Student Confidence in Academic Success	18.59	18.557	.519	.640
Instilling Value for Learning	18.58	18.288	.563	.613
Behaviour Control in the Classroom	19.38	21.676	.434	.689
Calming Disruptive Students	19.07	17.526	.498	.657

Table 5-8 provides insights into the impact of individual items on the scale's reliability.

Table 5-8. Factor 1 scale statistics (pre-test)

Mean	Variance	Std. Deviation	Items (n=)
25.21	30.853	5.555	4

In addition, 95% Confidence Intervals and F-tests with a true value of 0 were conducted, as shown in Table 5-9.

Table 5-9. Factor 1 intraclass correlation coefficient (pre-test)

Measure	Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	.384	.495	3.491	96	288	<.001
Average Measures	.714	.796	3.491	96	288	<.001

Notes

Two-way mixed effects model where people effects are random and measures effects are fixed.

a Type C intraclass correlation coefficients using a consistency definition. The between-measure variance is excluded from the denominator variance.

b Estimator is the same, whether the interaction effect is present or not

c Estimate is computed assuming the interaction effect is absent because it is not estimable otherwise

Furthermore, intraclass correlation coefficients were computed using a consistency definition. The Type C intraclass correlation coefficients using a consistency definition are provided, with the between-measure variance excluded from the denominator variance. The details of the estimators are outlined in the notes section of Table 5-9.

These Omega values help to build a general knowledge around the internal consistency and reliability of Factor 1, which implies that this construct is strong. All these findings taken together give a good assessment of the reliability of the measurement tool for Factor 1 under pre-test conditions.

5.4.3 Analysis of Factor 2

In the assessment of the reliability of Factor 2 (Efficacy in Instructional Strategies), which includes items 1 (Establishing Classroom Management Systems), 3 (Utilizing Assessment Strategies), 5 (Encouraging Student Collaboration) and 9 (Implementing

Alternative Strategies), a thorough examination of statistical indicators was conducted using pre-test data (see Tables 5-10, 5-11 and 5-12).

Table 5-10. Factor 2 item-total statistics (pre-test)

Item	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Establishing Classroom Management Systems	18.43	22.186	.578	.750
Utilizing Assessment Strategies	17.94	22.142	.625	.726
Encouraging Student Collaboration	16.92	25.243	.495	.787
Implementing Alternative Strategies	18.09	20.293	.705	.682

Table 5-11. Factor 2 scale statistics (pre-test)

Mean	Variance	Std. Deviation	Items (n=)
23.79	37.332	6.110	4

Table 5-12. Factor 2 intraclass correlation coefficient (pre-test)

		95% Confidence Interval		F Test with True Value 0			
	Intraclass Correlation[a]	Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	.485[b]	.383	.588	4.772	96	288	<.001
Average Measures	.790[c]	.713	.851	4.772	96	288	<.001

Notes

Two-way mixed effects model where people effects are random and measures effects are fixed.

a Type C intraclass correlation coefficients using a consistency definition. The between-measure variance is excluded from the denominator variance.

b Estimator is the same, whether the interaction effect is present or not

c Estimate is computed assuming the interaction effect is absent because it is not estimable otherwise

For Factor 2, the satisfactory Cronbach's Alpha of 0.750 affirmed acceptable internal consistency. Detailed item-level analyses, including mean if deleted, variance if deleted, corrected item-total correlation and Cronbach's Alpha if deleted, offered insights into each item's contribution to reliability. Noteworthy positive correlations were observed for Establishing Classroom Management Systems and Utilizing

Assessment Strategies, while Encouraging Student Collaboration and Implementing Alternative Strategies demonstrated robust contributions. The evaluation of test-retest reliability through Intraclass Correlation Coefficients indicated moderate to high stability (0.485 and 0.790). The 95% Confidence Interval for ICC values reinforced Factor 2's consistency over time. Additionally, for Factor 2, McDonald's Omega values, with Establishing Classroom Management Systems (0.777), Utilizing Assessment Strategies (0.742), Encouraging Student Collaboration (0.789) and Implementing Alternative Strategies (0.693), underscored notable internal consistency.

These comprehensive findings contribute to a holistic understanding of the reliability Factor 2 in the pre-test conditions, emphasising their stability, robustness and internal coherence in capturing the nuanced aspects of the constructs under investigation.

5.4.4 Analysis of Factor 3

In the assessment of the reliability of Factor 3 (Efficacy in Technology Integration) and comprising items 4 (Integrating Technology with Instruction), 7 (Adapting Technology to Learning Tasks) and 11 (Perceiving Technology's Role in Teaching Enhancement), diverse reliability metrics were scrutinized using pre-test data (see Tables 5-13, 5-14 and 5-15).

Table 5-13. Factor 3 item-total statistics (pre-test)

Item	Scale mean If Item deleted	Scale variance if item deleted	Corrected item-total correlation	Cronbach's Alpha if item deleted
Integrating Technology with Instruction	12.68	10.720	.565	.549
Adapting Technology to Learning Tasks	13.76	12.079	.470	.669
Perceiving Technology's Role in Teaching Enhancement	12.59	11.745	.521	.607

Table 5-14. Factor 3 scale statistics (pre-test)

Mean	Variance	Std. Deviation	Items (n=)
19.52	22.544	4.748	3

Table 5-15. Factor 3 intraclass correlation coefficient (pre-test)

		95% Confidence Interval		F Test with True Value 0			
	Intraclass Correlation[a]	Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	.439[b]	.317	.559	3.351	96	192	<.001
Average Measures	.702[c]	.582	.791	3.351	96	192	<.001

Notes

Two-way mixed effects model where people effects are random and measures effects are fixed.

a Type C intraclass correlation coefficients using a consistency definition. The between-measure variance is excluded from the denominator variance.

b Estimator is the same, whether the interaction effect is present or not

c Estimate is computed assuming the interaction effect is absent because it is not estimable otherwise

The calculated Cronbach's Alpha for the full scale was 0.549, indicating a moderate level of internal consistency. Comprehensive individual item analyses, considering mean if deleted, variance if deleted, corrected item-total correlation and Cronbach's Alpha if deleted, offered nuanced insights into the contribution of each item to the overall reliability. Particularly noteworthy was the robust positive correlation observed for Adapting Technology to Learning Tasks, while Integrating Technology with Instruction and Perceiving Technology's Role in Teaching Enhancement also demonstrated substantial contributions. The evaluation of test-retest reliability through Intraclass Correlation Coefficients showcased moderate to high stability for both single and average measures (0.439 and 0.702, respectively). The 95% Confidence Interval for ICC values further underscored the temporal stability of Factor 3, ranging from 0.317 to 0.559 for single measures and 0.582 to 0.791 for average measures.

Collectively, these findings contribute to a comprehensive understanding of the reliability of the measurement instrument for Factor 3 in the pre-test conditions, emphasising its stability and internal consistency over time.

5.5 Presenting Results

This section will present the quantitative findings that are relative to Research Questions 1 and 3 which focus on aspects of pre-service teachers' self-efficacy on

teaching strategies classroom management and technology integration whose central theme is on the self-efficacy scores of pre-service teachers and the changes observed over time. The second research question, which addresses the pre-service teachers' adaptation of technology after ETP and PPE, will not be delved into as we will discuss its findings in the next chapter following the qualitative analysis.

This section consists of the following sub-sections:

- Assessment of Self-efficacy
- Assessing Changes in Self-efficacy

5.5.1 Assessment of Self-efficacy

The analyses in Section 5.4 explore whether PSTs perceive themselves to possess sufficient levels of knowledge, experience and self-efficacy to be classroom-ready for teaching with technology and offer insights into the preparedness of Saudi Pre-Service Teachers. While mean values for knowledge, experience and self-efficacy factors are provided, it is important to note that the full answer to this question will be addressed in the discussion section, drawing upon both qualitative and quantitative data.

The factors (Section 5.3.9) investigated were:

1. Efficacy in classroom management and engagement.
2. Efficacy in instructional strategies.
3. Efficacy in Technology Integration.

The estimation results of the participants level of self-efficacy are shown in Table 5-16.

Table 5-16. Pre-test self-efficacy results

Factor	Statistic	Result	Std. Error
F1_ECME	Mean	6.3015	0.14099
	95% confidence interval for mean – lower bound	6.0217	
	95% confidence interval for mean – upper bound	6.5814	
	5% Trimmed mean	6.3134	
	Median	6	
	Variance	1.928	

Factor	Statistic	Result	Std. Error
	Std. deviation	1.38863	
	Minimum	3	
	Maximum	9	
	Range	6	
	Interquartile range	2	
	Skewness	-0.068	0.245
	Kurtosis	-0.445	0.485
F2_EIS	Mean	5.9485	0.15509
	95% confidence interval for mean – lower bound	5.6406	
	95% confidence interval for mean – upper bound	6.2563	
	5% Trimmed mean	5.9791	
	Median	6	
	Variance	2.333	
	Std. deviation	1.5275	
	Minimum	1.75	
	Maximum	9	
	Range	7.25	
	Interquartile range	2	
	Skewness	-0.141	0.245
	Kurtosis	0.031	0.485
F3_ETE	Mean	6.5052	0.1607
	95% confidence interval for mean – lower bound	6.1862	
	95% confidence interval for mean – upper bound	6.8241	
	5% Trimmed mean	6.5613	
	Median	6.3333	
	Variance	2.505	
	Std. deviation	1.58269	
	Minimum	2.67	
	Maximum	9	
	Range	6.33	
	Interquartile range	2	
	Skewness	-0.404	0.245
	Kurtosis	-0.473	0.485

Factor 1 has a mean of 6.30, with a confidence interval of 6.02 to 6.58. The mean for Factor 2 is 5.94, which has a confidence interval of 95% between 5.64 and 6.25. Factor 3 has a mean of 6.50, with a confidence interval of 6.18 to 6.82.

Saudi pre-service teachers demonstrated a strong sense of self-efficacy in instructional strategies and the integration of technology, with mean scores of 6.30 and 6.50, respectively. This suggests a high level of confidence and readiness in employing effective teaching methods and incorporating technology into their instructional practices. However, in student engagement and classroom management with technology, teachers exhibited moderate self-efficacy, as indicated by a mean score of 5.94. While this signifies a reasonable level of readiness, there is a degree of variability in teachers' confidence in effectively managing classrooms and engaging students when utilizing technology. This assessment was conducted on a 9-point scale anchored with the notations: nothing, very little, some influence, quite a bit, a great deal. The assessment utilized a 9-point scale, with endpoint labels ranging from "nothing" to "a great deal." The pre-results revealed that Saudi preservice teachers fell within the range of responses categorized between "some influence" and "quite a bit" (see Appendix E).

5.5.2 Assessing Changes in Self-efficacy

To support traditional statistical methods such as Paired Sample T-test, the researcher performed a Bootstrap analysis to investigate the evolution of self-efficacy, a comparative analysis was conducted between Time 1 and Time 2. The results from the Paired Sample T-test and Bootstrap analysis are in the following sub-sections of this section.

Paired Sample T-test

The paired samples test results, focusing on pre-service teachers' self-efficacy across the factors are further elucidated by considering effect sizes, a common interpretation framework proposed by Cohen (1988), in Table 5-17.

The factors investigated (Section 5.3.9) were:

1. Efficacy in classroom management and engagement.
2. Efficacy in instructional strategies.
3. Efficacy in technology integration.

The investigation into the changes in teachers' technological self-efficacy through course participation (Section 5.4) revealed insightful results. However, it is imperative to note the limitation imposed by the small sample size, as only 12 participants were matched for comparison purposes. This constraint significantly impacts the generalizability of observed changes, particularly in the context of statistical significance.

Table 5-17. Paired (pair 1) samples test.

	Paired Differences							
				95% confidence interval of difference				
Pair[a]	**Mean**	**Std. Dev**	**Std. Error Mean**	**Lower**	**Upper**	**t**	**df**	**Sig. (2-tailed)**
F1 ECME _T1 – F1 ECME _T2	-1.25	1.46	.424	-.316	-2.18	-2.94	11	.013
F2 EIS _T1 – F2 EIS _T2	1.23	1.74	.503	.121	2.336	2.44	11	.033
F3 ETE _T1 – F3 ETE _T2	.694	1.69	.488	-.379	1.768	1.42	11	.182

Notes

a Pairs are Factor and Time combinations, Factor is abbreviated to F and Time to T. "F3_T2 – F3_T1" is therefore "Factor 3, Time 2" paired with "Factor 3, Time 1".

- The paired samples effect sizes for Factor1_Time1 compared to Factor1_ ECMSE _Time2 were calculated using standardized measures, including Cohen's d and Hedges' correction. The point estimates for Cohen's d and Hedges' correction were 1.46 and 1.52 respectively. Furthermore, 95% confidence intervals were computed to provide a range of plausible values for the effect sizes. For Cohen's d, the confidence interval ranged from -1.503 to -0.171, while for Hedges' correction, it ranged from -1.451 to -0.165.
- The effect sizes for Factor1_ ECMSE _ Time1 compared to Factor1_ECMSE _Time2, as measured by Cohen's d and Hedges' correction, are both large (Cohen's d = 1.47, Hedges' correction = 1.52). This indicates a substantial practical impact of the intervention on the observed outcome. Furthermore, the significance level (p-value) associated with the paired samples test is 0.013, suggesting that the observed differences are statistically significant. This

addition further emphasizes the practical impact of the observed results on technology Efficacy in Classroom Management and Student Engagement, including:

- Building Student Confidence in Academic Success
- Instilling Value for Learning
- Behaviour Control in the Classroom
- Calming Disruptive Students

Trends displayed in Figure 5-2 support the suggestion that the observed differences (Table 5-17) are statistically significant.

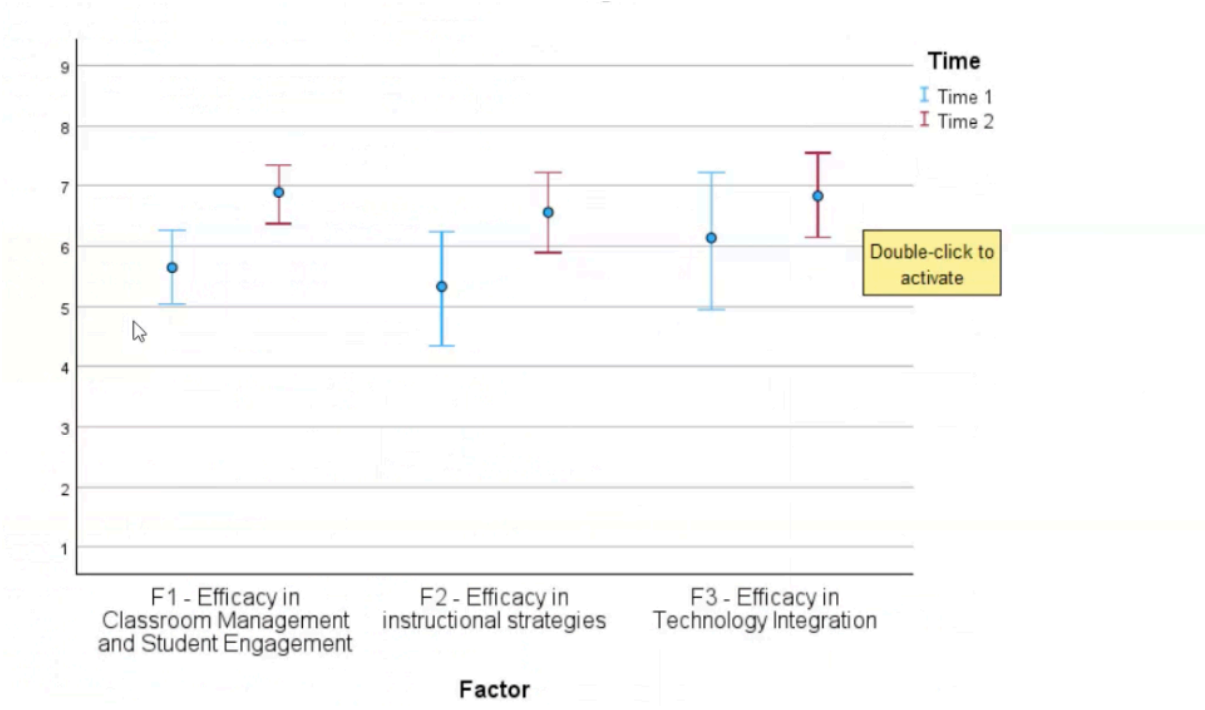

Figure 5-2. Effect sizes and significance levels for factors at Time 1 and Time 2

Moving on to Factor 2_EIS (Efficacy in instructional strategies), the effect sizes, as measured by standardiser effect sizes, showed notable increases from Time 1 (1.74) to Time 2 (1.87), indicating a substantial improvement in Efficacy in instructional strategies. The significance level associated with Factor 2 was found to be 0.033 in the two-sided test, demonstrating statistical significance, as observed from the respective data points Figure 5-2. Furthermore, the paired samples statistics revealed an increase from Time 1 (5.33) to Time 2 (6.56).

These findings suggest a substantial improvement in the participants' abilities to implement effective instructional strategies, including:

- Establishing Classroom Management Systems
- Utilizing Assessment Strategies
- Encouraging Student Collaboration
- Implementing Alternative Strategies

Moving on to Factor 3_ETE, which focuses on integrating technology with instruction, participants demonstrated notable improvements in their efficacy. The effect sizes, as measured by standardiser, increased from Time 1 (1.69) to Time 2 (1.81), indicating a substantial enhancement in participants' ability to integrate technology into instructional practices.

This factor encompasses various aspects, including:

- Integrating Technology with Instruction
- Adapting Technology to Learning Tasks
- Perceiving Technology's Role in Teaching Enhancement
- Although the significance level associated with Factor 3_ETE was 0.182 in the two-sided test, suggesting a non-significant result, as evident from the patterns illustrated in Figure 5-2, paired samples statistics revealed an increase from Time 1 (6.13) to Time 2 (6.83), highlighting the effectiveness of the intervention in enhancing participants' technology integration skills within instructional contexts.
- Paired samples tests were conducted for all three factors. For Factor 1 (F1), a significant difference was found between F1_ECMSE _T1 and F1_ECMSE _T2, with substantial effect sizes indicated by Cohen's d = -1.25 and Hedges' correction = -2.18 (p = 0.013). Similarly, Factor 2_EIS (F2) displayed a significant difference between F2_T1 and F2_T2 (p = 0.033), with considerable effect sizes of Cohen's d = 1.23 and Hedges' correction = 0.121. However, Factor 3_ETE, showed a non-significant difference between F3_ETE _T1 and F3_T2 (p = 0.182), with a moderate effect size of Cohen's d = (1.69) to Time 2 (181). These results suggest varying degrees of change

across the factors, with F1 and F2_ EIS demonstrating notable differences and F3_ETE showing less pronounced changes over time.

Acknowledging the limitation of the small, matched sample size, qualitative data will be employed in the final discussion to triangulate and provide a more comprehensive understanding of the observed changes. This approach aims to enhance the robustness of the study's findings and address the inherent constraints associated with the limited sample size in drawing conclusive implications.

Bootstrap Analysis

In addition to traditional statistical tests, a Bootstrap analysis, as described by Horowitz (2019), can provide insights into the stability and reliability of the observed effects on pre-service teachers' self-efficacy across the factors in this study. The Bootstrap method can be applied for interval estimation of the mean, under the assumption that observations are independent and come from the same distribution. The results are shown in Table 5-18.

Table 5-18. Bootstrap for paired (pair 1) samples test

					95% Confidence Interval	
Pair[a]	Mean	Bias	Std. Error	Sig. (2-tailed)	Lower	Upper
F1CM_T2 – F1_T1	1.22917	.00669	.47031	.031	.35417	2.18750
F2_T2 – F2_T1	1.25000	.00123	.38977	.006	.43750	1.95833
F3_T2 - F3_T1	.69444	-.00247	.48927	.186	-.36041	1.63889

Note

a Pairs are Factor and Time combinations, Factor is abbreviated to F and Time to T. "F3_T2 – F3_T1" is therefore "Factor 3, Time 2" paired with "Factor 3, Time 1".

Factor 1 (Efficacy in Classroom Management and Student Engagement) exhibited a Bootstrap mean difference of 1.22 and a Bootstrap bias of 0.00. The Bootstrap 95% Confidence Interval (CI: 0.35 to 2.18) is consistent with the initial findings, reinforcing the statistically significant and practically substantial improvement in self-efficacy for classroom management and student engagement.

For Factor 2 (Efficacy in Instructional Strategies), the Bootstrap analysis reveals a mean difference of 1.25 with a Bootstrap bias of 0.00. This small bias indicates minimal distortion in the estimated mean difference, supporting the robustness of the observed improvement. The Bootstrap 95% Confidence Interval (CI: 0.43 to 1.95)

aligns with the original paired samples test, further confirming the substantial and statistically significant impact on self-efficacy in instructional strategies.

For Factor 3 (Efficacy in Technology Integration), the Bootstrap mean difference of 0.69, Bootstrap bias of -0.00 and Bootstrap 95% Confidence Interval (0.36 to 1.63) confirm the non-significant change observed in the paired samples test. While the Bootstrap analysis suggests a moderate effect size, the lack of statistical significance emphasizes the need for cautious interpretation of practical significance within the evaluated timeframe as shown in Table 5-18.

In summary, the Bootstrap analysis substantiates the results of the paired samples tests, providing additional confidence in the observed effects on self-efficacy across the three factors. It reinforces the substantial impact on instructional strategies and classroom management while emphasizing the need for careful consideration of practical implications in technologies integration.

5.6 Results for Individual Teachers

Analysis of the factors for pre-service teachers (PSTs), revealed a professional growth and proficiency spectrum as shown in Table 5-19.

Table 5-19. Self-efficacy scores for all participants

	Factor 1 Efficacy in classroom management and engagement Means			Factor 2 Efficacy in instructional strategies Means			Factor 3 Efficacy in technology integration. Means		
PST	**Time 1**	**Time 2**	**Diff**	**Time 1**	**Time 2**	**Diff**	**Time 1**	**Time 2**	**Diff**
PST1	5.50	6.25	0.75	2.50	6.50	4.00	3.67	5.67	2.00
PST2	4.00	8.00	4.00	4.75	7.25	2.50	6.33	8.00	1.67
PST3	6.25	7.50	1.25	5.00	8.00	3.00	7.67	8.33	0.67
PST4	5.75	8.25	2.50	8.00	6.75	-1.25	7.67	7.67	0.00
PST5	4.50	6.00	1.50	2.50	5.00	2.50	2.67	4.67	2.00
PST6	7.00	7.50	0.50	8.25	8.00	-0.25	7.00	9.00	2.00
PST7	5.50	6.75	1.25	5.50	8.25	2.75	5.67	7.00	1.33
PST8	4.25	5.75	1.50	5.25	5.50	0.25	3.00	6.67	3.67
PST9	6.75	6.75	0.00	6.00	6.00	0.00	7.67	7.00	-0.67
PST10	7.25	5.25	-2.00	6.00	4.75	-1.25	6.33	5.00	-1.33
PST11	6.50	7.75	1.25	6.25	7.25	1.00	9.00	7.33	-1.67
PST12	4.50	7.00	2.50	4.00	5.50	1.50	7.00	5.67	-1.33

Further analysis is contained in the following sub-sections:

- Analysis of Factor 1 Results
- Analysis of Factor 2 Results
- Analysis of Factor 3 Results
- Variation in Results Over Time

5.6.1 Analysis of Factor 1 Results

For Factor 1 (Self-efficacy in Classroom Management and Student Engagement), every experience of the PST gives hints of both positive and negative aspects that are used to improve the instruction.

PST1 showed an elevated level of effectiveness in classroom management and student engagement in both Time 1 and Time 2, with scores rising from 5.50 to 6.25, which means proactive attempts to stimulate a positive learning environment.

PST2 revealed a remarkable leap in proficiency as the scores changed from 4.00 to 8.00. This increase reflected a significant improvement in classroom management along with a better engagement of the students.

PST3 successfully upgraded the class management system and strengthened the students` engagement through this efficacy score rise from 6.25 to 7.50.

The PST4 effectiveness was initially improved from 5.75 to 8.25. Then there was a small drop to 8.25, however, with the reflections, we were able to identify factors that influenced the classroom management.

The PST5 clearly demonstrated a notable increase in learning effectiveness from 4.50 to 6.00, suggesting the instructor’s adherence to classroom management skills and students’ interactions.

PST6’s efficacy slightly declined from 7.00 to 7.50, therefore disclosing the hidden factors that, in fact, affect the positive outcomes of classroom management.

PST7 demonstrated a remarkable improvement in the efficacy from 5.50 to 6.75, implying a dedication in preserving an effective learning atmosphere and encouraging student involvement.

PST8 gradually increased its effectiveness from 4.25 to 5.75 highlighting the importance of being proactive in improving learning environment.

Classroom management and student engagement were the key features of PST9 which remained at a stable level with a score of 6.75, ensuring that an appropriate learning environment had been maintained.

To address challenges in classroom management and student engagement, targeted support in PST10 is needed to bring the efficacy down from 7.25 to 5.25.

PST11 respectively demonstrated a notable rise in effectiveness, from 6.50 to 7.75, which showed her attentiveness to devise more effective classroom management strategies and increase student involvement.

PST12 represented an impressive progression from 4.50 to 7.00 in the effectiveness of classroom management skills, leading to better engagement of students.

In summary, the individual growth plots of PSTs concerning classroom management and student engagement give us an understanding of the complexity of instruction development that can then be used to drive tailored improvements and resource provisions that encourage continuous growth.

5.6.2 Analysis of Factor 2 Results

For Factor 2 (Efficacy in Instructional Strategies), the data (Table 5-19) derived from self-efficacy in instructional strategies indicated varying level of experiences as well as development among the participants.

PST1: Shown a significant growth of self-efficacy, the score jumped from 2.50 to 6.50. It manifests a noteworthy development in their growing ability as well as effectiveness in delivering classroom instruction.

PST2: Likewise, experienced a great improvement, their score increasing from 4.75 to 7.25. The development of AI assistants is the major milestone in their competence of implementing instructional techniques to aid students in learning.PST3: The cohort demonstrated remarkable progress, as the self-efficacy score improved from 5.00 to 8.00. Such a significant improvement demonstrates that they have gained confidence in designing and implementing teaching that is effective.

PST4: However, the study group experienced a slight decrease in self-efficacy as their score fell from 8.00 to 6.75. However, this decline is worth a mention, but it is quite

minor and their score remains high, suggesting that they are still mastering the instructional strategies despite the slight decrease.

PST5: Showcased a remarkable progress, as their score raised from 2.50 to 5.00. This remarkable transformation reveals their efforts to deepen their teaching style and improve their teaching efficiency.

PST6: Demonstrated a slight drop in self-efficacy as they scored 8.25 earlier and 8.00 now. Nevertheless, it is a small decrease, and the score is still high as it shows a steady level of mastery of instructional strategies.

PST7: Showed great progress, their self-efficacy score improved from 5.50 to 8.25. Such considerable progress shows their commitment to improving their teaching methods and creating good learning environments.

PST8: Demonstrated a slight improvement in self-efficacy as their score went up from 5.25 points to 5.50. Although this increment is small, it is evidence of a gradual advance in their level of confidence and proficiency in instructional strategies.

PST9: Kept their self-efficacy constant, with the scores remaining unchanged at 6.00. Such stability points to a continuing level of trust and aptness in using the instructional methods.

PST10: There was self-efficacy decrease and their score fell from 6.00 to 4.75. With this slip, the issue of possible challenges or obstacles on the way to implementing these education strategies becomes apparent.

PST11: They demonstrated remarkable improvement, which was reflected in their self-efficacy score that rose from 6.25 to 7.25. This considerable improvement shows their determination to rework teaching methods and raise the effectiveness of teaching.

5.6.3 Analysis of Factor 3 Results

For Factor 3 (Efficacy in Technology Integration), it is important to note the significant improvements seen in several participants' self-efficacy scores (Table 5-19) over time.

PST1 has clearly evolved from 3.67 initially to 5.67 with respect to using technology successfully and their confidence in their ability to integrate technology.

During the second quarter of the year, PST2 saw tremendous growth illustrated by the fact that their score increased as high as 8.00 in comparison to the previous quarter of 6.33. This showed a good progress in the area of technology utilization in teaching.

Thus, PST3 feedback rating rose from 7.67 to 8.33, meaning their certainty in integrating technology into teaching pedagogy also improved.

Among the PST students, the scores for PST5, PST6 and PST7 showed an important developmental trend with their self-efficacy scores having significant gains throughout the training courses to manifest their increasing determination to empower themselves with the technological information and skills required for their current and future work.

Even those participants such as PST8, who in the beginning generally had a lower self-efficacy score (3.00), this group still managed to progress with quite high rate, with their score rising to markedly higher number, that is 6.67, meaning that they have considerably improved their technology integration confidence and skills.

Ultimately, the brought to light the pivotal role of continuous teaching and learning progress and the event of professional development activities in support of the growth of pre-service teachers' competence and confidence in mastering technology use as one of the teaching tools in education.

Participants such as PST7 described empowering integration of technologies, implying their rigidness in using technology in teaching. Nevertheless, there were problems with decreasing self-efficacy when it came to technology application in PST10, PST11 and PST12. This gap shows where the participants from the workshop may be having problems in using technology well in their teaching styles.

In brief, the data above shows a wide range of professional development and competence including planning instruction, caring for students and the use of technology. Through analysing self-efficacy paths, both areas of growth and struggles are shown displaying the exceptional calibre of educational progression.

5.6.4 Variation in Results Over Time

The data analysis (Table 5-19) shows significant variations in individual participant results in terms of the breakdown of each factor from Time 1 to Time 2.

As for Factor 1, which evaluated “Efficiency in classroom management and engagement”, the proportion dropped from 50.00% at Time 1 to 32.03% at Time 2. Similarly, Factor 2, which talks about Efficacy of instructional strategies, saw an increment in its proportion from 22.73% to 30.78% between Time 1 and Time 2. Additionally, Factor 3 which is Efficacy in technology integration rose proportion from 27.27% at the first point in time to 37.19% at the second point in time presented in Figure 5-3.

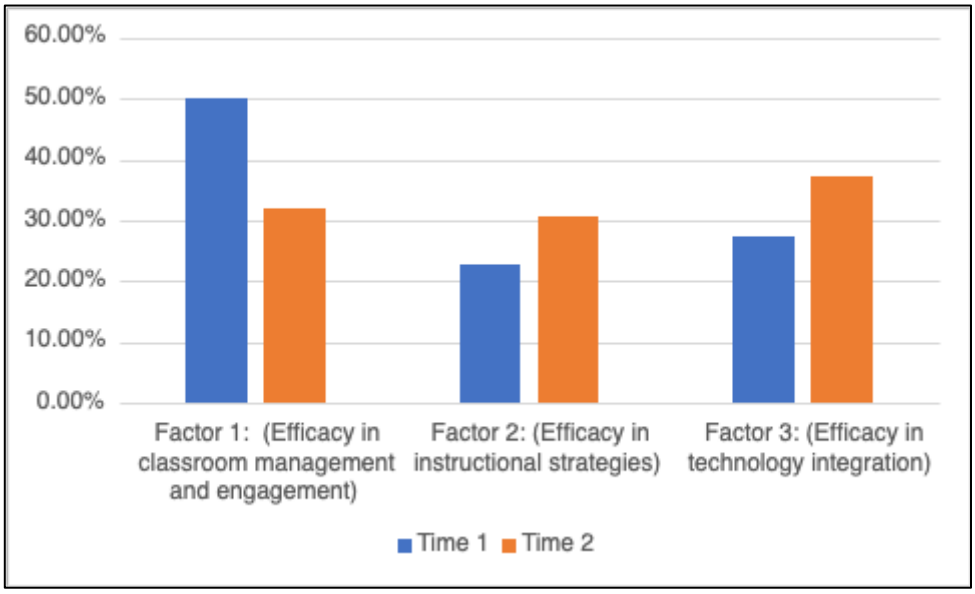

Figure 5-3. Individual participant results

In summary, there was a decrease in Factor 1 (F1) from Time 1 to Time 2, while Factors 2 (F2) and 3 (F3) exhibited increases. This suggests that certain factors have changed to varying degrees over time. Specifically, the upward trends observed in Factors 2 and 3 imply potential improvements occurring over time.

Also, it should be noted that the results given below are based on a relatively small sample size of 12 participants, who were intensely studied, observed and interviewed throughout the intervention period. These explorations at the individual level offer valuable information in respect of the experiences and views of every participant. On the other hand, the aggregate results shown in the Figure 5-3 are derived from the data coming from the whole group, which consists of people who had the intervention as well as those who did not. Thus, we emphasize the complexity of the research findings as well as the need to take into consideration individual and group-level data in the interpretation of results. The individual-level analysis represents a detailed view

of the participants' experience, on the contrary, the group-level analysis offers a broader view of the pre-service teachers' efficacy as a whole following the intervention.

5.7 Chapter Summary

This section contains the following sub-sections:

- Limitations of the Quantitative Research
- Strengths of Quantitative Results
- Conclusion

5.7.1 Limitations of the Quantitative Research

The absence of a control group is a critical limitation to this study that poses a barrier in arriving at concrete conclusions regarding the practical implications related changes observed on pre-service teachers' self-efficacy within timeframes assessed. It may be difficult to isolate the specific impact of the ETP course intervention due to not having a control group, as other outside forces could have influenced changes reported. Although statistically significant and practically substantial improvements were found in instructional strategies and classroom management, a moderate effect on technologies integration was observed. However, the lack of control group suggests caution when attributing all these changes to that course. Further studies need to include a control group or focus on other environment-specific factors which could clarify how the course affects self-efficacy.

5.7.2 Strengths of Quantitative Results

In the current research, significant contribution to Teacher Sense of Efficacy Scale research in the Saudi context was attained by introducing new tools for measuring pre-service teachers' perception of self and mastery of technology. The research adopts literature-based definitions and delves into a fourth factor focused on the assessment of pre-service teacher proficiency in the use technology in alignment with the evolutionary nature of educational technology (Bueno-Álvarez et al., 2023; Ho et al., 2023; Tran, 2023; Safitri, 2021). The innovation of this study is the fact that it creates the new-found reality in the field of education technology when it comes to understanding the needs and requirements of the Saudi pre-service teachers. In this

respect, the work of Bueno-Álvarez et al. (2023) is presented to provide evidence of the reliability and validity of a Spanish version of TSES and further that the three-factor construct was supported together with the focus on convergence and consistency in predicting overall self-efficacy of teachers.

On the other hand, this study provides an alternative three-component model for assessing pre-service teacher self-efficacy, in which the classroom management is represented by student interactions. This departure from the four-factor model is similar to that of Bueno-Álvarez et al. (2023) who also left a four-factor model and gave a modern and comprehensive account of the association between factors in terms. This method allows a more informative understanding of their beliefs in themselves, what can be an advantage to pre-service teachers in the Saudi environment and also shows the importance of taking into consideration the cultural peculiarity and technological mediation on the assessment of teacher self-efficacy.

The work of Ho et al. (2023) was about the factor structure of the TSES for in-service teachers in Vietnam and concluded that the three factors from the original sources could prove relevant to high school teachers within that country. This is consistent with this study's alternative three-factor approach. Studies restructuring factor in different cultural environments suggest the value of taking such factor structures into consideration, providing support to the argument about the factor-specific approach for Saudi pre-service teachers (Ho et al., 2023; Tran, 2023).

5.7.3 Conclusion

In conclusion, this chapter presents a detailed study on the results of from the experimental factor analysis conducted in Saudi Arabian educational context. One area of focus in this study is the reliability and validity assessment of Teacher Self-Efficacy Survey (TSES), especially regarding users' experience. Furthermore, one can confirm the credibility of this survey as a valid and reliable tool owing to findings in the research. It is important to mention that the measurement models discussed constitute an initial analysis aimed at addressing RQ1: Do PSTs perceive they have sufficient levels of knowledge, experience and self-efficacy to be classroom-ready to teach with technology? And RQ3: Does Saudi pre-service teachers' self-efficacy changes through the participation in a ETP & PPE?

This design modification serves to strengthen the views of pre-service teachers, based on their user experiences that have enlightened them as they make decisions about integrating technology with suitable teaching approaches. This experimental factor analysis validates the teacher self-efficacy survey which, further customized to include Technology Integration can be a strong data collection instrument. Its attention to user experiences grants a deepened comprehension of pre-service teachers' perceptions and assists in making knowledgeable decisions on the incorporation of technology into the pedagogical system. Chapter 6 presents the results of pre-service teachers' views on their TPACK & SAMR level and how their sense of understanding changed throughout field experience.

6. Teacher Engagement with TPACK and SAMR

This chapter consists of the following sections:

- Introduction
- Terminology Used
- Participants
- Case Study – Lamia
- Case Study – Aqbal
- Case Study – Aisha
- Case Study – Ahlam
- Case Study – Ahood
- Case Study – Iasmin
- Case Study – Afnan
- Case Study – Sanaa
- Case Study – Haia
- Chapter Summary

6.1 Introduction

This chapter provides the findings from nine case studies of pre-service teachers who concurrently undertook both professional placement experience (PPE) and an Educational Technology Programme (ETP) course over twelve weeks to complete their degree requirements.

The chapter introduces each PST's initial assessment of their own knowledge and self-efficacy before describing their personal engagements with the TPACK and SAMR models, discussed in more depth in Chapter 7. Understanding each PST's story provides insight into the range of experience that exists in using technology for teaching, the extent to which teachers can move from substituting technology for traditional teaching tools to fundamentally transforming their pedagogy and the effects of external factors (such as access to ICT materials) on their capacities. This

chapter therefore describes the findings from the observations and interviews with the nine PSTs before discussing the theoretical significance of these findings in Chapter 7.

6.2 Terminology Used

The results in this chapter show the various ways that PSTs were able to enhance their own teaching and interaction with educational technology by referring to (in their own words) or demonstrating awareness of (through their conduct) various features of the TPACK and SAMR models. These models are used in this thesis because they each address a crucial component of the research topic, which is the perceptions of self-efficacy, the lack of skills (SAMR) and the lack of knowledge (TPACK) of PSTs. PTS knowledge needs are the centre of the TPACK model, which emphasizes the interaction of pedagogical, tecchnological and content knowledge.

The following acronyms are used in this chapter to denote these elements:

- CK – Content knowledge
- PK – Pedagogical knowledge
- TK – Technological knowledge
- PCK – Pedagogical Content Knowledge
- TPK – Technological Pedagogical Knowledge
- TCK – Technological Content Knowledge
- TPACK – Technological Pedagogical and Content Knowledge

These elements are described in Section “Introduction to TPACK”. Figure 6-1 illustrates connections between these elements, explaining the knowledge that teachers have about content, pedagogy and technology, as well as the overlap between these types of knowledge.

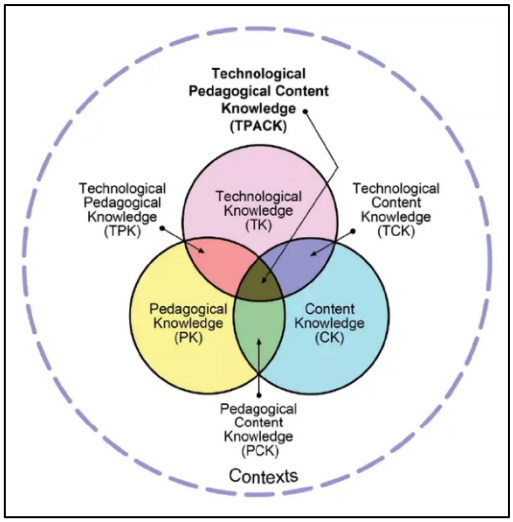

Figure 6-1. TPACK and components

In the SAMR model, learning and teaching are described using a four-level taxonomy:substitution, augmentation, modification and redefinition.

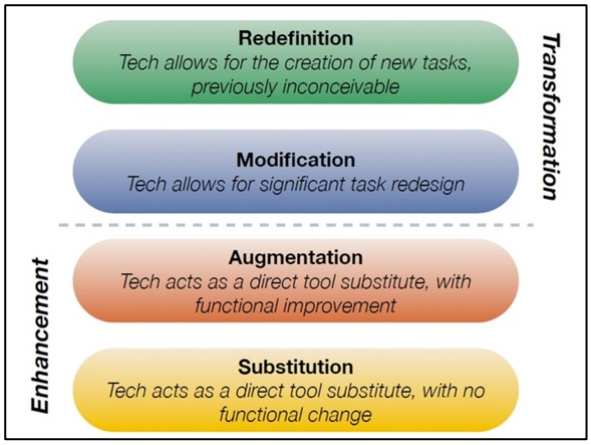

Figure 3-2. SAMR model (Puentedura, 2020)

Each level of the SAMR Model builds on the previous level's technology use and is divided into enhancements and transformations of teaching.

The SAMR model is used here as a theoretical lens, to understand and evaluate the integration of technology in PSTs lesson. The SAMR emphasizes their practices and how technology influences the learning experience. It can also guide educators to move beyond mere substitution or augmentation to more transformative uses of technology and allow researchers to assess the extent to which technology can truly transform the learning experience. Both models are useful aids in the planning, assessment and evaluation of technology's use in teaching and learning and integrating them aligns with the goal of preparing pre-service teachers to offer

students meaningful and innovative learning experiences while navigating complex educational landscapes. In particular, PSTs can use the models to evaluate their technology integration practices and aim for the higher levels of the SAMR model that encompass modification and redefinition.

6.3 Participants

All pre-service teachers (PST) who participated in the study were final-year students in an Initial Teacher Education degree programme undertaking professional placement experience (PPE) and an Educational Technology Programme (ETP) course over 12 weeks (two hours per week on Zoom's web portal) concurrently to complete their degree requirements.

The details of the nine participants, using pseudonyms for confidentiality, are shown in Table 6-1.

Table 6-1. Participants, specialisation and school levels

Pseudonym	Specialisation	School Level
Lamia	ICT	Secondary School (grades 7-9)
Aqbal	Science	High School (grades 10-12)
Aishah	Science	High School (grades 10-12)
Ahlam	Islamic studies	Secondary School (grades 7-9). Note studies of the Holy Quran and Islam were merged into one curriculum-based specialisation in 2022 (MOE)
Ahood	English language	High school (grades 10-12)
Iasmin	Islamic studies	High school (grades 10-12)
Afnanh	Mathematics	High school (grades 10-12)
Haia	Kindergarten	No placement due to Covid 19 restrictions
Sanaa	Islamic studies	High school (grades 10-12)

Of the students, one was unable to complete her PPE due to Covid-19 restrictions, and, as such, she was observed completing micro-teaching at the university. Each of the remaining PSTs was assigned a supervisor from the university from the same curriculum specialisation and a mentor-teacher at the school. The PSTs specializing in Information Technology (ICT) encountered difficulties due to the lack of ICT mentor-teachers. As a result, the school principal created a mentor-mentee relationship within the school and found a willing mentor-teacher with ICT skills from another school.

All nine participants were observed by the researcher during their micro-teaching presentations at university as part of their course requirements.

In the 2020-2021 academic year, the Saudi Ministry of Education established a new learning management system (LMS) for distance teaching and learning called the "Madrasati" platform. Several supplementary educational tools were included within this platform, which provided some of the most important remote learning education programs in Saudi Arabia (Aldossry, 2021; Shishah, 2021). Thus, the nine pre-service teachers were equipped to utilise this platform to communicate with their students, send comments and have discussions. During the closure of schools and lockdown restrictions caused by the COVID-19 pandemic, teachers used the Madrasati platform to conduct online teaching and assessment of student academic performance.

It is worth emphasising that use of technology in Saudi schools had been limited up to the time when they were integrated into the state educational system. A traditional method of instruction prevailed and heavily relied on face-to-face interaction. Digital learning infrastructure, before the launch of Madrasati, had limited reach within Saudi's conventional "bricks-and-mortar" educational system. This was marked by a break from the traditional educational landscape during the COVID-19 pandemic, when school closures and lockdown measures caused a drastic change to digital education platforms such as Madrasati. The shift from conventional face-to-face instruction to online teaching marked a significant move from one paradigm to another in the teaching and learning environment in Saudi Arabia. For example, interactive whiteboards are commonly used around the world in classrooms to facilitate learning and interaction experiences, but they are not yet routine in the Saudi environment.

While this meant that PSTs had the potential to influence teaching by embracing this IT innovation, individuals' levels of training, preparation and actual capacities to engage with the new technology varied, as did their perceptions of their own self-efficacy as teachers in these circumstances. This chapter illustrates some of the psychological, pedagogical and technical factors that affect how PSTs relate to technologies for education, including the Madrasati platform.

The nine participants were observed by the researcher during their micro-teaching presentations at university to provide comparability of the data from observations

across all the participants in the study. As the participants spoke Arabic exclusively, the interviews were conducted in Arabic, with the researcher translating interview transcripts for the purpose of conveying their intended meaning (Corden & Sainsbury, 2006) for the purpose of analysing and presenting the results. The qualitative results were obtained from a combination of interviews, classroom observations and focus group sessions. Transcripts were reviewed by participants for accuracy and their translated quotations in the thesis have not been altered for grammatical or word use purposes except where necessary for clarity (McMullin, 2023).

The case studies in the following sections serve as exemplars of pre-service teachers' interactions with TPACK and SAMR. The investigations provide concrete examples and scholarly insights into the pragmatic application of these models in teacher education.

6.4 Case Study – Lamia

Lamia is a pre-service teacher majoring in Information Technology and undertaking her professional placement experience in a secondary school in which she taught digital skills to students aged 12-14 years old.

During the placement at the school, Lamia encountered a major challenge due to the lack of an ICT specialist mentor teacher on staff: "There is no [digital technologies mentor] teacher at the school, only me". Fortunately, the school mitigated this by establishing a mentor from a nearby school.

6.4.1 Initial Knowledge and Understanding

Prior to enrolling in the Information Technology major, Lamia had a superficial understanding of technology, as she explained:

> After I entered the Information Technology major, my knowledge of technology increased. The [ETP] training course benefited me in the education process and my specialization. (Lamia, personal communication, Dec 13, 2021)

Despite her initial hesitation and uncertainty about integrating technology into her teaching methods as she was "a little bit confused and afraid", Lamia gradually gained confidence as she observed her students' heightened engagement and happiness when

the technological tools were incorporated into their learning. The positive transformation encouraged Lamia to persist in incorporating ICT into her planning and teaching.

While she possessed the necessary curriculum content and technical knowledge, apprehension about the practical application made delivering lessons a challenging experience. Moreover, Lamia encountered technical challenges within the school environment, as there was no computer room and there were limited computers available for students to use independently. However, drawing on her knowledge of digital learning techniques and interactive teaching approaches, Lamia persevered to overcome these obstacles, ensuring a successful and engaging classroom experience.

6.4.2 Development of Effective Teaching (TPACK)

The intention of the ICT subject Lamia taught was to instruct students how to use Microsoft® applications in their studies. However, due to limited technological resources, only a small group of students had hands-on experience with PowerPoint and Word during each lesson; the rest were confined to observing a projector. This scenario raised concerns for Lamia, as she feared that the lack of hands-on experience could disadvantage those who were unable to actively engage with the technology during lessons.

Lamia believed the integration of ICT within the classroom was crucial for student engagement, a belief supported by her observations of deeper engagement and students being happier as a result. As she said: “I noticed my students becoming more engaged and happier.” To assist with her presentations, Lamia used PowerPoint to deliver her lessons, saying, “I can design PowerPoint lessons.” She created links to videos, games and other resources to make the lessons interactive and engaging for the students, mentioning, “I made links to games when there were special games on sites for lessons to give my students quick feedback about the lesson.”

However, she also identified certain obstacles in the form of limited accessibility to technology within the school. Specifically, she relayed that she had to use her personal laptop for classroom instruction, as the school lacked sufficient equipment for students. Despite these challenges, Lamia remained committed to leveraging technology to enhance her students’ learning experience.

Lamia implemented a teaching approach that entailed the posing of interactive questions in WhatsApp chat (TPK). “My efforts included organizing student activities, interacting via WhatsApp with students through interactive questions and awarding points for the students who answered correctly.” By employing WhatsApp as a platform for interactive questions and student engagement (TK), she effectively combined her understanding of teaching methods and content (PK) with the technology’s capabilities. Her approach of organizing student activities and using interactive questions aligned with her content objectives (CK) while taking advantage of the available technology to enhance student participation and learning (TK). Overall, Lamia’s teaching approach exemplified the integration of technological, pedagogical and content knowledge through WhatsApp for interactive learning experiences.

Lamia created bespoke activities such as enabling the students to showcase their work as they could “interact via WhatsApp with their peers by making interactive questions (PK). As the students became more involved in the activities, Lamia’s feelings of confusion and worry eased. She gave an example of how games were used to gain student engagement in learning through her knowledge of Technological Pedagogical Knowledge (TPK):

> We have a website called the Wordwall® that I used with my students to provide feedback and as a learning tool in which the girls interacted. It is a feedback game that my students benefit from because they learn from each other’s mistakes and my students prefer this game. [Wordwall has many games suitable for students]. How did you find this ICT tool? I learned about it through my mentor teacher, as the Ministry has integrated it into the curriculum, offering both customizable and pre-designed lesson content. Is it tailored to a particular educational stage? As far as I know, it being suitable for all educational levels. In practice, I employ it after the lesson, embedding it into my PowerPoint presentations and engaging my students in discussions related to the lesson using this game. The game format can be use it either group-based or individual. (Lamia, personal communication, Dec 13, 2021)

PowerPoint presentations were used, incorporating links to videos (TK), games and other resources to make her lessons interactive (PK) and engaging for the students (TCK). She also used various tools (TK), such as digital activities (TPK), brochures

(CK) and grading systems (TK), to make her teaching process more efficient and effective (PK). Lamia rated herself as "almost an expert" in using technology and believed that her self-efficacy and experience played a complementary role in producing education materials after the professional placement experience.

Lamia felt very confident in her understanding of information and communication technology content (CK). Despite facing some challenges with limited resource access, Lamia explained how she was able to overcome them as an ICT specialist:

> I'm almost an expert. How? I can design PowerPoint lessons and put links to transfer to videos, for example, if it is a video from YouTube or anywhere. I make links to games if there are special games on sites for lessons to give my students quick feedback about the lesson. For example, in the previous lesson, I added pictures, videos and sounds. (Lamia, personal communication, Dec 13, 2021)

Lamia also demonstrated strong self-efficacy by describing herself as "almost an expert" when it came to the use of PowerPoint and other technologies in education. Her confidence in her abilities with technology had a direct influence on the design of her lessons. She believed that having experience with technology and a strong sense of self-efficacy were essential for creating successful educational experiences for students. As Lamia explained:

> The process is complementary. You must have experience in technology and your self-efficacy needs to be good to produce something good for students. (Lamia, personal communication, Dec 13, 2021)

Furthermore, Lamia rated herself as almost an expert in using technology, believing her self-efficacy and experience played a supporting role in producing quality education materials: "I am almost an expert, as I can design lessons and enrich them with tools for the content".

Lamia was confident and effective in using technology:

> Almost 10/10. I feel comfortable and efficient. …The educational technology process is easier for me. It's better than holding a book and reading from it. When more girls [students] benefit from the education process, my self-

> confidence increases because of the use of technological tools that facilitate the educational process. (Lamia, personal communication, Dec 13, 2021)

As students became more engaged, Lamia gained confidence and continued to give her best:

> I have become more capable in using technology in my classes, not such as in the old days. I was a little bit confused and afraid, but once I noticed my students become more engaged and happier, I gained confidence to complete these methods. (Lamia, personal communication, Dec 13, 2021)

The next section will Demonstrate how technology tools are used in the classroom to enhance learning align with the different levels of technology integration proposed by SAMR.

6.4.3 Development of Effective Teaching (SAMR)

Lamia's instruction incorporated the SAMR model of technology integration. She *substituted* her chalkboard teaching with PowerPoint presentations and *augmented* her lessons by supplying extra links to videos and interactive sources with other materials that could be used for engagement. Lamia moved beyond augmentation to *modification* by adopting technology-based special games to involve students in the process, while creating a quick way of feedback. Altogether Lamia's changes turned traditional lessons into engaging lessons.

In the current context, *redefinition* had not been completed. Future steps might involve adopting virtual reality simulations or promoting worldwide collaboration through technology. These measures could help redefine the learning experience, fostering deeper engagement and critical thinking beyond traditional teaching methods.

A summary of Lamia's development is shown in Table 6-2.

Table 6-2. Summary of Lamia's development

SAMR Level	Description	Examples
Substitution	Used PowerPoint presentations instead of traditional chalkboard teaching	Delivered lessons through PowerPoint presentations
Augmentation	Enhanced teaching by creating links to videos and interactive resources, providing supplementary content and engagement opportunities.	Provided links to videos and interactive resources to support the lessons

Modification	Went beyond substitution and augmentation, making lessons interactive and engaging for students through technology	Incorporated special games Wordwall and quick feedback using technology to change the learning experience
Redefinition	While believing ICT integration is crucial for engagement, did not fully achieved redefinition, which would involve transforming the learning experience in a unique way	No evidence of this level in the lesson

6.4.4 Summary of Journey

Lamia was specialized in using technology, but without experience or without practice and when she was given the opportunity to practice and use it in her specialty with theories, she felt that she was an expert and that she was 100% capable "Almost 10/10. I feel comfortable and efficient". She believes that in the beginning, she did not need knowledge of technological tools because that is her specialty, but the desire to practice and apply them, which is what allowed her to do so in the short-term program.

Lamia's approach demonstrates a transformation at the SAMR level through the integration of special games and feedback in the teaching and learning process. While Lamia applied herself to integrating ICT for student engagement, she faced initial challenges due to limited access to technology resources and, although she had strong IT knowledge (her teaching major), she was inexperienced in pedagogy.

After studying in the Educational Technology Program, she successfully combined her content knowledge (of technology) into the planning and teaching of her lessons, thus overcoming her earlier hesitation and discomfort. Resource limitations notwithstanding, she adeptly utilized tools such as PowerPoint and WhatsApp, demonstrating her adaptability. Lamia's commitment to technology integration showcased her capacity to overcome obstacles and adapt her pedagogical skills to improve student engagement.

6.5 Case Study – Aqbal

Aqbal was a high school pre-service teacher who taught the science curriculum to students. Her professional placement experience was supported by a school-based mentor teacher of basic sciences and she was also guided by a university supervisor. Aqbal initially assessed herself as "... a beginner. I need more experience."

6.5.1 Initial Knowledge and Understanding

Aqbal explained how pre-service teacher self-efficacy correlates with their use of technology, stating:

> When the PST is hesitant and does not have enough experience on how to use technology in teaching, meaning the thing she presents detracts from her efficiency; she does not know how to give more information and doesn't have enough resources and choices. (Aqbal, personal communication, Dec 14, 2021)

This statement reflects Aqbal's perspective on how a teacher's hesitation and lack of information can impact their competence and presentation skills.

She stated that when it comes to her approach and self-assessment of using technology before interacting with experienced mentor-teachers in the actual teaching programme and sharing with groups:

> I think I am still just a beginner because I lack enough experience. (Aqbal, personal communication, Dec 14, 2021)

She added:

> My general understanding in methodology such as cooperative learning, group teaching, the rotating chair and mind mapping in topics, is related to my chemistry specialty. However, on this I feel that I am not skilful enough; I am just a 7 out of 10. (Aqbal, personal communication, Dec 14, 2021)

6.5.2 Development of Effective Teaching (TPACK)

After participating in both PPE and the ETP, Aqbal had the chance to apply her acquired knowledge alongside seasoned educators. In her reflections, she highlighted that the placement offered a valuable opportunity for her to gain hands-on experience and apply teaching technologies.

In her comments, she mentioned that the professional placement experience was a great opportunity for her to learn and apply the teaching technology:

> I was able to observe experienced teachers and learn from their methods, which helped me to develop my own skills and confidence. For example, the spinning wheel, I learned this strategy through one of the mentor teachers. I

> started learning these tools when I was studying at university, but it was during the professional placement experience that I had the chance to apply them in a real-world setting. (Aqbal, personal communication, Dec 14, 2021)

She said that using technology in the classroom enhanced the learning experience for students. It made the subject matter more interesting and interactive and it allowed students to explore and learn at their own pace. She noted that it is important for teachers to be well-versed in the technology they are using, so they can use it effectively and efficiently.

In both my observations and our interview, Aqbal exhibited strong Technological Knowledge (TK) and Technological Pedagogical Knowledge (TPK). She was confident in using technology and effectively incorporated tools such as PowerPoint presentations, Google Drive and YouTube videos in her lessons. This demonstrated a proficiency in using technology to enhance student learning experience (TK).

In addition, her use of these tools to simplify complex lessons and engage students indicated her ability to apply pedagogical strategies with technology (TPK):

> I used technology to facilitate information for students when there was a complex lesson that I wanted to simplify for my students. (Aqbal, personal communication, Dec 14, 2021)

Aqbal demonstrated a grasp of pedagogical principles, linking cooperative education, group learning, rotating chairs and mind maps with technology to create engaging and effective learning experiences. Through her use of technology, she supported content delivery, reflecting her Technological Content Knowledge:

> I can take lessons, search for information, design assignments or tests, send messages to the students on WhatsApp and send assignments. I am responsive if the supervisor asks us for a specific task using technology, I can handle these things. (Aqbal, personal communication, Dec 14, 2021)

Aqbal valued technology (TK) as a tool but prioritized diverse pedagogical methods (PCK) to engage her students effectively. While incorporating technology, she ensured minimal distractions to keep her students focused (TPK), demonstrating her

thoughtful and appropriate use of technological, pedagogical and technological pedagogical knowledge for meaningful learning experiences:

> It's a good thing to use and add technology in lessons, but I only add a few things to keep my students focused. (Aqbal, personal communication, Dec 14, 2021)

Aqbal was motivated to use technology to make complex lessons more accessible for her students. She changed her teaching method and adopted new technological tools based on the lesson and its requirements. She noted: "I use Google Drive and YouTube to show short videos to the students. Recently, I used a video of reptiles for the students to facilitate the delivery the information". Thus, using live modelling session had the power to enhance student comprehension.

She described how she developed multimedia resources and how she engaged students to foster a more inquiry-driven learning experience:

> During the presentation, I shared pictures with the students, prompting them to make observations and guess the topic of the day. I adapt my use of tools based on the lesson requirements or goals I want to achieve with my students.
>
> In my case, my self-efficacy improved during field placement and I now feel confident in using technology in my lessons. I have a better understanding of how to plan and implement technology-enhanced lessons and I have a wealth of resources at my disposal to support my teaching. (Aqbal, personal communication, Dec 14, 2021)

Aqbal describes the development of her self-confidence and use of ICT to teach as she attributed this development after observing experienced teachers as a good example of introducing ICT in their lessons in PowerPoint. Firstly, the PST was excited and had positive thoughts towards the use of technology for teaching "I have complete confidence; because I can use the computer and link it to the teaching process." She discussed her proficiency in several programs, creating slides and incorporation of technology into her instruction "I am effective in it... I can handle these things". Her optimistic attitude indicated that she was becoming increasingly more comfortable using technology and, as a result, more confident.

In addition to this, Aqbal recognized the fact that she was an amateur user of technology prior to her teaching experience and sought opportunities for more practice. It was this awareness and desire to learn which gave her an active attitude towards the development of her ICT proficiency: “No, I was not ready at first, but after the field training, I became prepared through practice and application”. The use of technology in her teaching methods and practiced techniques could add more substance to what she discussed in class stating: “Everything applied and practiced differed and the efficiency rose to me”.

The next section will demonstrate how use technology tools to develop effective teaching align with the different levels of technology integration proposed by SAMR.

6.5.3 Development of Effective Teaching (SAMR)

In a science lesson Aqbal taught on plant and animal cells, she integrated technology at Substitution level, by *substituting* physical drawings with PowerPoint presentations to demonstrate the structure of cells. She *augmented* explanations of cell differences by using YouTube videos and integrated visuals/animations into PowerPoint presentations. There was no evidence of substantial task modification or redefinition.

A summary of Aqbal’s development is shown in Table 6-3.

Table 6-3. Summary of Aqbal’s development

SAMR Level	Description	Examples
Substitution	Used technology as a direct substitute for a traditional task with no functional change	Showed plant and animal cells lesson through a digital presentation (PowerPoint) instead of using physical drawings
Augmentation	Used technology to enhance the learning experience by adding improvements, but the core activity remained similar	Showed video clips from YouTube to demonstrate the differences between plant and animal cells. Used visuals and animations in PowerPoint to aid in explaining cell structures
Modification	No evidence of this level in the lesson	No evidence of this level in the lesson
Redefinition	No evidence of this level in the lesson	No evidence of this level in the lesson

6.5.4 Summary of Journey

Aqbal’s approach demonstrates enhancement at the SAMR level in her additional of functional improvements to a task. Aqbal reflected on her developing belief and faith

in the integration of technology in education. She was excited about incorporating technology and demonstrated some proficiency with incorporating different tools. She understood she was a novice at the beginning of the course and PPE and her need for improvement, noting how confident she became with computers and the delight she had in adopting technology in the classroom.

Furthermore, she was looking forward to undertaking further learning. It was this awareness and desire to learn that gave her an active attitude towards the development of ICT proficiency.

6.6 Case Study – Aisha

Aisha was a pre-service teacher specialising in secondary Chemistry education. She identified herself as a newcomer to educational technology, and, despite her limited experience, recognized the potential of technology to enhance her teaching methods. Aisha employed various digital tools such as videos, audio and images to simplify complex chemical concepts and engage her students effectively. Her proactive use of technology showcased her determination to bridge the gap between traditional teaching and modern digital learning experiences.

Aisha's confidence in using technology, albeit as a beginner, was evident. She possessed a basic understanding of tasks such as downloading and incorporating technology into her lessons. However, she acknowledged that her self-efficacy regarding technology directly impacted her ability to incorporate ICT efficiently. This insight underscored the role of self-efficacy in influencing the effectiveness of technology integration.

6.6.1 Initial Knowledge and Understanding

Aisha highlighted some of her concerns as a pre-service teacher regarding integrating ICT into her lessons, articulating her desire for increased experience with technology to gain a deeper understanding of various programs and their integration within the curriculum. She stated:

> I needed to gain experience in programs/tools and be more in-depth with them. I knew PowerPoint superficially. At the beginning of the ETP course, I needed to be competent in integrating technology. (Aisha, personal communication, Dec 14, 2021)

Aisha identified the connection between her confidence in using technology and her teaching efficiency, acknowledging “Indeed, it affects efficiency and the extent of its [ICT] ability. If I could use technological tools, my efficiency will be higher.” She acknowledged that her level of technological prowess influenced her ability to deliver lessons effectively and underlined the importance of building self-efficacy as a means of enhancing teaching practices through technology.

Aisha consistently highlighted her desire for increased exposure and hands-on experience with technology. She described herself as a beginner, stating: “I lack sufficient experience in using technology since I only recently started incorporating it into my routine.”

When asked about the role of self-efficacy in deciding to use technology, she affirmed:

> Certainly, its impact is linked to our proficiency and the extent of our abilities. If one possesses the skills to use technological tools, their efficiency is bound to increase. (Aisha, personal communication, Dec 14, 2021)

After completing the ETP, she articulated:

> I acquired a comprehensive understanding of PowerPoint. Subsequently, through collaboration with peers during field training, I further developed proficiency in its utilisation. (Aisha, personal communication, Dec 14, 2021)

Through the completion of the course and PPE, Aisha remarked: “At the end, I was very different.” The examples that follow illustrate Aisha’s initial uncertainty and later pride in her growth, highlighting the transformation she experienced in incorporating technology into her teaching.

6.6.2 Development of Effective Teaching (TPACK)

When considering the alignment of teaching strategies with technology, Aisha offered insights into her approach. She acknowledged her capability to use technology for practical tasks such as downloading resources to enhance her lessons. She employed various multimedia elements, such as video clips, audio clips and images, to facilitate lesson explanations and simplify content for her students (TCK).

Aisha established connections between the chosen educational strategies and technology integration to capture students’ attention. She highlighted instances in

which video clips supported the introduction of lesson content (TCK), tailoring imagery and activities to align with the subject matter (–PK, TPK). Aisha's ability to employ specific techniques in her lessons underscored her grasp of both content and technology integration (TPACK):

> The lesson was based on a video clip so they [students]could know the lesson's content (TCK). In classes where I used pictures, I demonstrated the correct activity for the students (PK). For example, if the lesson required a specific technique (CK), I could effectively demonstrate it to the students. (Aisha, personal communication, Dec 14, 2021)

Aisha acknowledged the availability of various programs and websites and she consciously chose to incorporate YouTube videos and pictures into her presentations:

> Maybe there are some programs or websites, but I did not use them. I only used pictures and videos from YouTube and added them to my presentations. (Aisha, personal communication, Dec 14, 2021)

During the professional placement experience, Aisha received valuable support from school-based mentor teachers, increasing her familiarity with technology tools. Her exposure to PowerPoint, for instance, was advanced through the guidance of experienced educators who enhanced her proficiency (TK):

> I needed to gain experience in programs and be more in-depth with them. I knew PowerPoint superficially, but the teachers in the professional placement experience taught me about PowerPoint and I was able to use it. (Aisha, personal communication, Dec 14, 2021)

Additionally, Aisha's peers enrolled in the ETP course created an atmosphere of encouragement, contributing to her growth in integrating technology into her teaching methods (Peer Support and TK). As she noted: "Encouragement from the group helped me and encouraged me to be more efficient in integrating technology."

Aisha's field placement primarily focused on acquiring technological pedagogical content knowledge (TPACK) skills. The emphasis was on demonstrating that cooperative learning is essential for developing technology in teaching practices (Collaborative Learning and TK). Specifically, Aisha improved her abilities to

integrate technical knowledge into her lessons through peer support and collaborative learning, which are integral components of the TPACK framework.

Aisha's journey exemplifies the dynamic interplay between her understanding of teaching strategies, technology integration and the support she received from both mentors and peers. Her growing proficiency in utilizing technology underscored the significance of a TPACK framework in effective teaching practices.

The next section will Demonstrate how technology tools are used in the classroom to enhance learning align with the different levels of technology integration proposed by SAMR.

6.6.3 Development of Effective Teaching (SAMR)

In Aisha's lesson about Mixtures and Separation Methods, she used digital presentations to *substitute* for traditional blackboard lessons. She also added interactivity and video clips to engage students, demonstrating *augmentation*.

However, the lesson did not provide evidence of *modification* or *redefinition* because there is no use of other, more transformative tools such as collaborative, web-enabled environments or simulator programs to profoundly change or redefine student learning experiences, in turn leading to higher involvement and comprehension.

A summary of Aisha's development is shown in Table 6-4.

Table 6-4. Summary of Aisha's development

SAMR Level	Description	Examples
Substitution	Used technology as a direct substitute without enhancing learning	Used digital presentations (PowerPoint) instead of physical transparencies or blackboard for teaching mixtures and separation methods
Augmentation	Used technology to enhance the learning experience by adding improvements, but the core activity remained similar	Incorporated interactive PowerPoint slides and videos to showcase examples of homogeneous and heterogeneous mixtures and separation methods
Modification	No evidence of this level in the lesson	No evidence of this level in the lesson
Redefinition	No evidence of this level in the lesson	No evidence of this level in the lesson

In summary, Aisha's lesson fell primarily into the Substitution and Augmentation levels. There was no evidence of significant Modification or Redefinition in the use of technology to transform the learning experience in the observed lesson.

The transformative stages of SAMR can be difficult to achieve. Depending on exactly what is done, 'virtual simulations' could be substitution or possibly augmentation. Adding collaboration might augment the learning experience without transforming it.

6.6.4 Summary of Journey

Initially, Aisha identified as being a novice in using and incorporating educational technology into her planning and teaching, but by the completion of the course and PPE, she had incorporated multimedia tools such as videos and images to simplify complex chemical concepts and engage her students. Her progression along the TPACK spectrum highlighted her developing skill in linking educational strategies with technology. During her field placement, mentor and peer support contributed to her technological proficiency, underscoring the collaborative aspect of skill development.

Through mentor guidance and peer encouragement, Aisha transformed her familiarity with PowerPoint into a more proficient skill. Examining her teaching through the SAMR model, Aishah's approach demonstrates an enhancement at the SAMR level, by Technology enhances the learning experience by adding improvements, but the core activity remains similar. Her integration of ICT tools elevated the learning experience yet retained the essence of traditional teaching methods.

Overall, Aisha's story demonstrated the adaptable and growth-oriented approach required to being an effective teacher in the digital era, especially as she continues to develop and refine her skills at a more foundational level.

6.7 Case Study – Ahlam

Ahlam was a pre-service teacher specializing in Islamic studies who completed her professional field placement in a Middle School setting. With guidance from the university and under the mentorship of an experienced teacher of Islamic Studies

within the school, Ahlam navigated the instructional landscape and applied her theoretical knowledge in a real-world setting.

6.7.1 Initial Knowledge and Understanding

Ahlam offered insights into her experiences, such as using illustrations and videos to teach complex topics “such as magic”. It’s important to note that in this context, “magic” did not refer to supernatural or occult practices, but rather encompassed a specific area within Islamic studies that involves exploring historical, cultural and religious aspects related to magical practices in the Islamic tradition. and employing a technological strategy (the spinning wheel) learned from a mentor teacher to enhance student engagement. As she mentioned:

> The spinning wheel, I learned this strategy through one of the mentor teachers. After each lesson, we do this technological strategy to distribute numbers to the students; the student whose number appears should answer the question. (Ahlam, personal communication, Dec 16, 2021)

It’s important to note that Ahlam’s lack of expertise was in using technology for teaching, not in her core discipline of Islamic studies. Her proficiency lay in her subject matter and she recognized the need to enhance her skills in integrating technology. As Ahlam stated: “I still need to become an expert in this thing.”

Ahlam rated herself at a medium level in using computers, acknowledging the ease in certain aspects but also highlighting challenges in lessons where she lacked background or experience in the subject matter. As she put it:

> Medium level, I am not an expert in using computers. It is easy; in some things, it is difficult to enter into; for example, in some lessons we took on the use of computers in education, without a background on the subject or its application and experience, the matter would be complicated. (Ahlam, personal communication, Dec 16, 2021)

Ahlam expressed a desire to become an expert in using technology and mentioned her effective use of technology in creating lessons independently. This reflected her proactive approach and interest in advancing her technological skills. As she asserted:

> Very effective. I did my lessons and created them myself without the help of anyone because since I started applying at the classes, I learned step by step,

> understood it and relied on myself with this thing. (Ahlam, personal communication, Dec 16, 2021)

6.7.2 Development of Effective Teaching (TPACK)

Ahlam's observed lesson integrated ICT in several ways: images and videos and a spinning wheel game to make difficult concepts easier for learners (TCK). She used technology in her planning and preparation (TK), her homework assignments (CK) and her communication with students (PK). Her motivation was clear, when she said: "[I]t's helped to motivate my students, it's what encourages you as the teacher to develop your own skills as an educator" and this led to her honing her own teaching abilities:

> I knew how to blend pedagogy with tech, so my students understood better.... In knowing the curriculum content of magic [Islamic studies] in my class, they were able to engage with that by connecting it with illustrations and/or videos for this purpose. They interacted with the content via a spinning wheel game...some students worked with the visual components, such as the illustrations or videos, answering questions, while others played the spin the wheel amongst one another. This interactive component allowed them to pick things up much quicker. (Ahlam, personal communication, Dec 16, 2021)

Ahlam highlighted her contributions in peer review and her discovery of new tools:

> I am satisfied, especially in peer review. I got acquainted with a new site for me from one of them is Canva. It served me a lot in terms of ready-made templates for lesson slides and I also used the spinning wheel to help my students to participate. (Ahlam, personal communication, Dec 16, 2021)

Ahlam chose WhatsApp (TK) to communicate with her students as she wanted an easy and efficient way to communicate (PK). Although the students were not learning at home, integration of WhatsApp was deemed necessary for uninterrupted exchange among her students and to improve learning experience for whole class. WhatsApp provided a direct link for reaching out with immediate answers or requests for information, exchange of urgent announcements and quick feedback on homework and tests. As she noted: "My method was modified. For example, I used WhatsApp to chat with students and I used it because I needed it for quick communication".

Ahlam elaborated that technology was helpful for her in following up with students through presentations. The term “nice” encapsulated ease of designing lessons “as it feels easy to design, flexible and nice”, flexibility provided in teaching methods and an overall positive and pleasant experience she associated with incorporating technology into her educational practices.

In essence, by using the term “nice,” Ahlam was conveying a sense of satisfaction, ease and positivity in her use of technology for educational purposes. Moreover, her optimistic attitude towards technology encouraged her to apply more innovative techniques and programs: “I did my lessons and created them myself without the help of anyone because since I started applying during the school classes, I learned step by step, understood it and relied on myself with the lesson planning.” She showcased how she leveraged technology and made her own virtual teacher tools, providing an example in which she used version of the spinning wheel tool. This tool is a technological strategy Ahlam learned during the ETP.

She describes application of the tool as follows: “After each lesson, we used this technological strategy [spinning wheel] to distribute numbers to the students; the student whose number appears should answer the question.” The spinning wheel serves as a random selection method, enhancing student engagement and participation. It’s a tangible example of how Ahlam incorporated innovative techniques into her teaching through technology.

> After each lesson, we used this technological strategy [spinning wheel] to distribute numbers to the students; the student whose number appears should answer the question. This tool was excellent because the students were focused and enthusiastic about participation and interaction. (Ahlam, personal communication, Dec 16, 2021)

Ahlam’s experiences with ICT had been positive during the ETP and she recognized that the university provided encouragement for enhancing her ICT Skills through the course and other programs. As she said: “Yes, there is a difference with technology. Everything has become more transparent and more understandable than before, through pictures, videos and sounds, unsuch as using a book only.” In addition, her quote: “Yes, there is a difference with technology. Everything has become more transparent and more understandable than before, through pictures, videos and

sounds, unsuch as using a book only" highlighted Ahlam's recognition of the positive impact of technology on teaching and learning.

In the context of university support, Ahlam said: "Yes, the university supports that through courses and raises our performance through programs [mean ETP] and follow-up," suggested that the university's encouragement for enhancing ICT skills through courses and programs contributed significantly to Ahlam's perception of technology as a transformative tool in education.

The next section will Demonstrate how technology tools are used in the classroom to enhance learning align with the different levels of technology integration proposed by SAMR.

6.7.3 Development of Effective Teaching (SAMR)

In Ahlam's observed lesson, she incorporated technology in several ways. At the *substitution* level, she used digital presentations such as PowerPoint to capture core content visually, using images of relevance for good understanding purposes. She *augmented* her lesson by using interactive approaches such as collaborative learning techniques entailing group activities, peer revisions and other technology-based instruments, as shown in Table 6-5. There was no evidence of substantive task *modification* or *redefinition* of learning activities in her lesson.

A summary of Ahlam's development is shown in Table 6-5.

Table 6-5. Summary of Ahlam's development

SAMR Level	Description	Examples
Substitution	Used technology as a direct substitute without enhancing learning	Used PowerPoint to visually convey content, asking students to deduce the lesson's subject through related images, thus enhancing engagement compared to verbal prompts alone
Augmentation	Used technology to enhance the learning experience by adding improvements, but the core activity remained similar	Incorporated a cooperative learning strategy involving groups, peer correction and a spinning wheel game. These interactive approaches leveraged technology
Modification	No evidence of this level in the lesson	No evidence of this level in the lesson

SAMR Level	Description	Examples
Redefinition	No evidence of this level in the lesson	No evidence of this level in the lesson

6.7.4 Summary of Journey

Ahlam's use of technology in her teaching falls within the enhancement level of the SAMR model, since technology enhances the effectiveness of tasks, by adding some functional improvement. Ahlam recognised her level of proficiency in computer usage, acknowledging ease in certain areas but facing challenges when integrating technology into lessons without prior subject knowledge.

Despite initial reservations, she credited the transformative impact of an educational program. Ahlam now exudes confidence and is poised to elevate her teaching with the introduction of electronic tests and innovative English teaching techniques. Her noteworthy improvement in self-efficacy was attributed to the support of university courses and programs, emphasising the acquisition of information, ideas and training. These elements collectively contribute to her ongoing development and increasing proficiency in leveraging technology for effective teaching.

6.8 Case Study – Ahood

Ahood was a pre-service teacher specializing in teaching English Language who completed her professional field placement in a Secondary setting. She was supported by a school-based mentor teacher and a university supervisor.

Ahood commented that she had an unreliable memory and used technology as a memory aid. She also identified that she had a passion for learning new programs and technological tools. In her self-assessment at the commencement of her placement, she placed herself at an intermediate level regarding integrating technology with pedagogy.

6.8.1 Initial Knowledge and Understanding

Ahood stated at the commencement of her placement:

> Considering my status as a learner and acknowledging the complexities of certain terms, particularly due to language barriers, I found that technology significantly simplified matters, particularly in generating audio recordings

through tools such as Google Translate to ensure accurate pronunciation of words.

Ahood also highlighted the importance of technology:

> [T]echnology played a pivotal role in orchestrating classroom activities, exemplified by the rotating name wheel I employed during one of my explanations. This innovation markedly enhanced my ability to regulate class participation and foster interactions. As I reflect on this, I gauge my competency in this aspect as intermediate. (Ahood, personal communication, Dec 19, 2021)

Ahood highlighted the importance of the ETP course with specialized technology educators in furnishing PSTs with examples and opportunities to integrate contemporary technological advancements into educational planning and teaching. She remarked:

> [O]ur current instructors are adept at imparting knowledge about computer applications and educational technology. This instruction proved invaluable, as these educators were well-versed in the latest technologies aligned with the current times. Notably, they introduced strategies specifically tailored for aspiring educators. (Ahood, personal communication, Dec 19, 2021)

Furthermore, Ahood observed the transformation occurring in educational institutions, stating:

> Contemporary schools heavily embrace technology, employing tools such as smart boards and projectors. This stands in contrast to my academic years, during which these resources were not ubiquitous in every classroom. Today, such resources are commonplace across public educational institutions. Consequently, acquiring proficiency in utilizing smart boards held exceptional significance and the training in Educational Technology comprehensively encompassed this essential facet. (Ahood, personal communication, Dec 19, 2021)

6.8.2 Development of Effective Teaching (TPACK)

Ahood used different technological programs and tools in delivering the English language curriculum. She applied different software such as Madrasati systems for

classroom management *"I am the type of person who forgets a lot, so I had to use the timer app to remind myself of appointments, classes and tasks."* Microsoft PowerPoint for delivering teaching content, CleverEnf as an interactive instruction interface, Canva for making instructional resources and WhatsApp for sharing content with learners. Additionally, Ahood presented her lessons using PowerPoint slides with imagery to support her teaching. Clearly, technological knowledge, pedagogical knowledge and technological pedagogical knowledge intersect in her teaching journey.

During Ahood's interaction with her peers, mentor teacher in the PPE, ETP she become familiar with new ICT tools and resources (TK). According to her:

> I developed a lot with one of the school teachers (mentor teacher) who used to have the same subject for the same class, I used to go back to her a lot in terms of technology. We brought an alternative for our students, a website that helps them understand the English curriculum.

It seems that engaging with a mentor teacher as a role model in the PPE has a positive effect on the ability and desire of a PST to explore new tools. Ahood credits the course she took in the preparation programme for giving her the basis of educational techniques and strategies: "These courses have equipped me with the new technologies and strategies to effectively integrate technology into my future lessons."

While Ahood acquired foundational knowledge of integrating technology in her teaching through the preparatory program, her mentor-teacher and university supervisor actively supported her in finding additional materials. This assistance helped Ahood customize the English curriculum, making it more accessible for students and aligning with the concept of Content Knowledge (CK).

Ahood followed this discussion by describing how engaging with peers in ETP has made her explore new materials and technological tools that make learning more fun for her students:

> I am satisfied [in using technology in class], especially with my peers. I got familiar with a new site for me from one of them (her colleagues) called Canva. Learning has become more fun and students are more attracted to the photos and videos that are added to the posts.

She added that it worked best for her in ready-made templates for slide presentations regarding particular subjects. As a result, Ahood benefitted from her partnership with peers and mentors in developing TPK competencies. developing her pedagogical approach integrate technology in meaningful and purposeful ways.

Ahood emphasized the benefits of using technology in teaching, which has enabled her students to access a wider range of resources and enhance engagement (TPK). She recognized the value of technology in enhancing the linguistic instruction of her students:

> Such as a WhatsApp group, I sent audio daily, conversations and lectures, in preparation for evaluations and they [students] came back to hear it at home many times.

Ahood gained insights into instructional methods of incorporating technology into classrooms when she engaged in collaborative talks and online meetings with colleagues (PK): “These courses have equipped me with the new technologies and strategies to effectively integrate technology into my future lessons.”

Her enhanced skills enabled her to facilitate some lessons in the textbook, as she noted:

> We had a site I used with my students called CleverEnf, especially for use in English lessons. It’s an interactive educational programme that provided the student and teachers with the English language curricula for all educational levels in the Kingdom of Saudi Arabia. It could present the textbook in a beautiful, creative, unprecedented interactive way. My students were complaining about the Ain platform and that the lessons in it were difficult in terms of the resources available in it and I sent them this site [CleverEnf] and another YouTube channel that I linked with it. (Ahood, personal communication, Dec 19, 2021)

Ahood reported that she incorporated technology into teaching to make difficult concepts for students more accessible (TCK) as well as identifying the benefit of technology in improving language teaching for her students. She would send audio, conversations and lectures daily using a “WhatsApp group or similar means”, explaining that students went through them many times, when returning home.

Through Ahood's co-operation with the mentor-teachers and other colleagues in education, she came to understand the best way to approach teaching the subject matters in connection with the use of the technologies (PCK). This is exemplified by her remark: "We brought an alternative for our students."

Ahood's development is evidenced by her involvement in shaping the formation of TPACK. Easily blending technology into her classroom instruction, she had a strong grasp of all three components, namely, technological, pedagogical and content knowledge. She remarked that "…with the pressure and tension we were in, I improved a lot and with the process of change; I see that I have become more efficacious".

The next section will Demonstrate how technology tools are used in the classroom to enhance learning align with the different levels of technology integration proposed by SAMR.

6.8.3 Development of Effective Teaching (SAMR)

In Ahood's observed English language class, she successfully applied technology in her teaching across different stages of SAMR. She used Canva and PowerPoint in *substituting* traditional static images with modern digitized ones, which were shared via WhatsApp, reflecting a commonly used communication means., with CleverEnf, Ahood created enhanced eLearning content demonstrating technology *augmentation*. Through CleverEnf, the teaching and learning process was elevated through the use of technology relevant to their new vocabulary.

Significantly, she achieved *modification* by having the students use WhatsApp to share their work, thus facilitating online interactions. These interactions significantly improved the knowledge acquisition process and presented new windows of opportunity. Ahood noted:

> It is an interactive educational service that serves the student and teachers in the English language curricula for all educational levels in the Kingdom of Saudi Arabia because it presents the textbook in a beautiful, creative, unprecedented interactive way. Besides worksheets and preparations, solutions, an illustrated dictionary and other free features, they such as it and find it interesting. (Ahood, personal communication, Dec 19, 2021)

The integration of interactive educational services, such as CleverEnf, notably enhanced the learning experience for students and teachers, offering the potential for a creative and unprecedented approach to presenting educational content in the English language curriculum across all levels in the Kingdom of Saudi Arabia. There was no evidence of *redefinition* in the observed lesson.

A summary of Ahood's development is shown in Table 6-6.

Table 6-6. Summary of Ahood's development

SAMR Level	Description	Examples
Substitution	Used technology as a direct substitute for a traditional task, with no functional change	Used Canva to create instructional materials, similar to PowerPoint presentations. Used. WhatsApp for content-sharing. Used PowerPoint/Canva presentations with images for listening and conversational skills, representing a traditional approach to teaching
Augmentation	Used technology to enhance the learning experience by adding improvements, but the core activity remained similar	Used CleverEnf to create instructional materials and include interactive elements, multimedia resources and potentially adaptive learning features that improve the learning experience for both students and teachers
Modification	Used technology to significantly redesign tasks, creating new possibilities not feasible without technology	Ahood's students shared their work through WhatsApp to learn from each other and foster a collaborative learning environment. Facilitated real-time communication and exchange of ideas outside the classroom
Redefinition	No evidence of this level in the lesson	No evidence of this level in the lesson

6.8.4 Summary of Journey

Ahood's use of technology in her teaching falls within the Transformation level of the SAMR model, as her students collaborated in real-time and shared their ideas outside the classroom by sharing their work online.

Ahood's journey shows that she was active towards adopting technological integration in her teaching. She initially described herself as an intermediate user of technology but soon learned the potential of incorporating technological tools to improve her pupils' leaning experience. The evidence of her readiness was shown by her desire to learn, ability to adjust to the dynamics of modern education and

appreciation of the assistance provided by her peers, mentor and supervisor on the way to becoming a digital age educator.

6.9 Case Study – Iasmin

Iasmin was a pre-service teacher specializing in teaching Islamic studies at high school level. She received mentorship from the religion teacher at the high school and a faculty member from the University. In her capacity as a pre-service teacher, she became increasingly comfortable with the convenience of technology, both practically and in terms of cost. Technology facilitated efficient lesson planning and saved time, making it easier for her to present materials to her students. For instance, she could readily update and enhance materials she's previously used, incorporating new information and advancing her teaching methods:

> Convenience in all respects, practically and financially. It facilitates planning and does not take much time, making it easier for you as a teacher to present it to your students. I mean, for example, there are some materials that I have memorized from the previous year. I can add a lot to them with my new information and add to them. This means that I am also progressing in teaching methods. (Iasmin, personal communication, Dec 20, 2021)

With the help of ICT, Iasmin added new information to existing materials, simplifying the teaching process, saving teacher time and enhancing the learning experience for students:

> I find it better and easier. Instead of going to libraries, it arranges a picture for me, puts words under it and makes paintings. All these things are facilitated by technology. I see that my display is prepared to define myself and send [to] the students how I want to communicate it. For example, I answer the audio and video clips I use most. For instance, I take ideas for video clips from YouTube and coordinate them or images from Google and explain them. (Iasmin, personal communication, Dec 20, 2021)

In Iasmin's opinion, teachers who lack confidence in their ability to present creative ideas can also negatively impact the learning of their students:

> I think that a person who is not confident in himself [or herself] or [in] his [or her] competence, even if he [or she] is creative in something, will not be able

> to present it correctly because he will be hesitant and not have complete confidence. This will affect the results of her teaching process. (Iasmin, personal communication, Dec 20, 2021)

Additionally, she indicated the importance of staying current with new technologies and programs for pre-service teachers:

> We have to learn about many programs we haven't used yet, so it is important to develop ourselves from time to time and be updated. (Iasmin, personal communication, Dec 20, 2021)

6.9.1 Initial Knowledge and Understanding

Iasmin had some initial reservations about using technology in teaching. However, her professional placement experience helped her overcome these reservations and she gradually became more confident in embracing technology. She realized that new technological approaches improved her teaching, demonstrating her adaptability and growth mindset. She noted:

> At first, there was reluctance to use technology, but after the fieldwork, things were excellent and I could explain these new technological ways. It increases, not decreases. (Iasmin, personal communication, Dec 20, 2021)

In addition to enhancing her skills and knowledge, Iasmin stayed up-to-date and competitive in a rapidly evolving digital landscape:

> The most important factor is that you see all people currently using technology; we do not want to be behind them, not only in education but in communication and everything; I see that the most important thing and I prefer that technology be used in education so that we will not be behind them. Because the world is developing and when, for example, when I go to study in a foreign country and I can't use these tools such as them (means developed countries), this will be awful. (Iasmin, personal communication, Dec 20, 2021)

According to Iasmin, pre-service teachers need to be more familiar with technology because it impacts the everyday lives of the new generation; they use technology for

communication, entertainment, education and a variety of personal and professional tasks. She said:

> In our previous studies, technology was not used, except for approximately 5% of my entire studies. When I came to this generation, I was studying; it was difficult because I used the same method, I learned with them [the students]. I had to use something else that understood them differently from us at the time, so it was necessary. Then, I modify to simplify the information, such as sounds with syllables for interaction. (Iasmin, personal communication, Dec 20, 2021)

6.9.2 Development of Effective Teaching (TPACK)

Iasmin used ICT to enhance student engagement, although she was initially reluctant to use technology. Once, in practice however, she embraced ICT to enhance student engagement. Reflecting on her experience, she mentioned:

> I was not very interested in the details of the presentation to the students, for example, my last lesson on the stages of human creation [part of Islamic studies]. I found the students very interactive because I presented them with a picture, audio and written content, which gave students the audacity to participate with me in the class. (Iasmin, personal communication, Dec 20, 2021)

This highlights the transition from initial reluctance to utilizing ICT effectively in her teaching approach, integrating technical knowledge, content knowledge and technological pedagogical content knowledge.

She also enabled the students to learn from each other's mistakes as they discussed and evaluated each other's recordings. She said:

> [I] created a group for students online in WhatsApp and the students recorded an audio clip to record their memorization of the Quran. A group of students evaluated their colleagues as they noticed each other's mistakes and learned from them. (Iasmin, personal communication, Dec 20, 2021)

With her use of video clips and some new tools, she incorporated a countdown strategy into the presentation:

> Following the descent of numbers with sound then the student pressed stop counting on the computer, revealing the name of the selected student [PK]. Subsequently, the chosen student would respond to the question posed by their peers through the loudspeaker. (Iasmin, personal communication, Dec 20, 2021)

She perceived herself as lacking experience in utilising technology, as she acknowledged that while she employs a projector for video work, she doesn't consider herself an expert, recognising the imperfections in her approach:

> I mean, okay, I use a projector to work on video, but in my way, I don't see it as perfect as I say to myself that I'm no expert in this thing. (Iasmin, personal communication, Dec 20, 2021)

As a result of technological advancements, the educational material became easier for students to understand (TCK):

> Yes, there are more teams, for example, when we want students to hear audio clips or show a specific video. Technology has a role in making the educational material more facilitated and simplified for students so that there is enough time to finish the lesson and answer their questions. (Iasmin, personal communication, Dec 20, 2021)

Nevertheless, when it comes to integrating the group posts (PK) through technology (TK), it may backfire. It has been implied by Iasmin that some students may be deprived of their right to education by lack of access to technology:

> Technology may divest the right of some students to education, as they [teachers and students] often use groups for distance learning and some of them [the students] withdraw and do not participate in that. (Iasmin, personal communication, Dec 20, 2021)

Iasmin initially experienced reluctance to use technology. However, following the fieldwork with ETP topics, she expressed a significant shift in her perspective, noting that things became excellent. She emphasized: "I could explain these new technological ways." Importantly, this experience led to an increase, not a decrease, in

her self-efficacy. As Iasmin aptly highlighted: “it is crucial to continuously develop ourselves and stay updated with evolving technologies.”

The next section will Demonstrate how technology tools are used in the classroom to enhance learning align with the different levels of technology integration proposed by SAMR.

6.9.3 Development of Effective Teaching (SAMR)

In the observed Islamic lesson, Iasmin utilized technology at the *Augmentation* level of the SAMR model, using a PowerPoint presentation to demonstrate the stages of human creation from the Holy Quran. A Quran audio playback accompanied the presentation, which walked students through the processes from sperm to egg, embryo to formation of foetus. She incorporated questions into the PowerPoint, fostering student engagement.

Through these approaches, the learning experience went beyond *substitution*, enhancing comprehension and interaction with the subject matter. There was no evidence of substantive task *modification* or *redefinition* of learning activities in her lesson.

A summary of Iasmin’s development is shown in Table 6-7.

Table 6-7. Summary of Iasmin’s development

SAMR Level	Description	Examples
Substitution	Used technology as a direct substitute without enhancing learning	Employed technology as a direct substitute for traditional methods, such as using digital images, an audio recording of Qur’anic verses and question delivery through PowerPoint
Augmentation	Used technology to enhance the learning experience by adding improvements	Enhanced the lesson by providing functional improvements. PowerPoint presentation included interactive images and animations of development stages
Modification	No evidence of this level in the lesson	No evidence of this level in the lesson
Redefinition	No evidence of this level in the lesson	No evidence of this level in the lesson

6.9.4 Summary of Journey

In Iasmin's lessons, she used technology to *augment* task effectiveness, adding some functional improvement. Based on the SAMR model, her use of technology falls under the Enhancement level.

Iasmin undertook a path of change and development with respect to technological competencies. She commenced the PPE with a minimum level of self-efficacy confidence but had the desire to learn and master new ICT skills. Her fieldwork experiences were instrumental in shaping Iasmin's journey, making them come alive through practice. Her active participation helped boost her confidence in making use of technology and developing an understanding that it could bring change. Initially, she was nervous about integrating ICT. However, with time, her self-efficacy improved and she became confident in using digital technologies.

The change in self-efficacy points to the significance of practical training and support in pre-service teacher education, as she mentioned: "After the fieldwork, things were excellent and I could explain these new technological ways. It [her self-efficacy] increases, not decreases. So, it is important to develop ourselves from time to time and be updated."

6.10 Case Study – Afnan

Afnan was a pre-service teacher who taught Mathematics in a secondary school. During her field placement, she was supported by a supervisor from the university and a mentor-teacher from inside the school.

Afnan contended that her utilization of technology revolved primarily around PowerPoint. She argued for the integration of technology tools exclusively within a PowerPoint-style framework. For example, while she linked search engine technology to web pages and incorporated auxiliary applications, such as Canva, to enhance the educational process, she did not mention tools that support Mathematics directly.

6.10.1 Initial Knowledge and Understanding

Afnan acknowledged that when she initially began incorporating ICT in her teaching, she had a basic level of competence. She felt comfortable with certain aspects of

technology integration and believed that she had a foundation to work from, stating that:

> In the beginning, I was not bad in using ICT in teaching; I knew some of the things that I had to do. (Afnan, personal communication, Dec 21, 2021)

Afnan explained that she acquired her initial knowledge and understanding of using educational technology through the ETP program, which exposed her to various software applications:

> I learned about using technology in teaching from the teacher preparation programme through applications such as Word, PowerPoint and [other] Microsoft Office suite [applications]. (Afnan, personal communication, Dec 21, 2021)

6.10.2 Development of Effective Teaching (TPACK)

In order to make her lessons more engaging and memorable, Afnan incorporated technology into her lessons. She said:

> I can diversify teaching methods and use more programs that enhance the education process and help the teaching more. (Afnan, personal communication, Dec 21, 2021)

She specified that technology broadened student perceptions and enhanced lesson planning and organization when she said: “The programs and technology tools I used to broaden the perceptions of students’ knowledge”. She also mentioned it can help teachers “to organize our files and time” and for her “Google Drive help me to collects and arranges my files and time.”

In addition, she suggested that using technologies improved both efficiency and recognition in teaching:

> When we use technology in it [lessons], it is easier and faster to manage my time and I always received praise from my supervisors, encouraging me to use technology. (Afnan, personal communication, Dec 21, 2021)

As a result, Afnan facilitated and simplified the tasks of the teacher with technology.

She indicated that, prior to enrolling into the ETP program, she viewed teaching mathematics as difficult and wondered whether she could teach as she had no

practice. However, through the training and collaborative group experiences, she not only gained proficiency with new technology tools, but also acquired a broader set of skills and knowledge essential for effective mathematics instruction. The programme provided her with pedagogical approaches, subject-matter knowledge and the ability to interact meaningfully with peers. As Afnan said: “I became more educated and knowledgeable about the subject, I used technology in the education process.”

She elaborated:

> One day I realised that I couldn’t teach math at all [meaning she couldn’t teach or wasn’t capable in conveying information to the students], so switched to presentation (PowerPoint) as my way of conveying information. I included video, graphics, tests and a voice over explanation. In addition, I added a slide showing a smiling face and sound for correct solutions and on the other hand, a sad face for wrong answers, to encourage students to try again when they failed. (Afnan, personal communication, Dec 21, 2021)

While Afnan noted that adding imagery to PowerPoint presentations could relate to the student answers (incorrect or correct), she did not believe that this was enough (TPACK).

Afnan heavily relied on technology, particularly PowerPoint, for essential tasks such as delivering lesson information and organizing content for students. Nevertheless, she seldom utilized technology to foster more personal interactions with students or address other aspects of engagement. In her words: “In the past, our main tool was PowerPoint, but we supplemented it with various strategies such as the wheel strategy, coloured cards strategy and the treasure-reaching strategy.”

She indicated that there are huge disparities between teaching without technology and teaching with it:

> Today’s teaching methods, with the aid of technology, are more effective and successful than traditional approaches, thanks to a wide range of valuable tools and resources such as online platforms, interactive software and digital content, as easy to engagement, accessibility. (Afnan, personal communication, Dec 21, 2021)

The next section will Demonstrate how technology tools are used in the classroom to enhance learning align with the different levels of technology integration proposed by SAMR.

6.10.3 Development of Effective Teaching (SAMR)

In Afnan's observed lesson, she discussed the fundamental elements of matrices. Using a PowerPoint presentation, she presented the lesson content concisely, explaining the elements and conceptual significance of matrices. Throughout the presentation, mathematical equations were illustrated with clear explanations. By focusing on worksheet exercises, students were able to identify specific matrices through interactive and application-based learning. Afnan used PowerPoint to facilitate a structured exploration of matrices, combining theory with practical problem-solving, enhancing student comprehension and proficiency, showing both *substitution* and *augmentation*. No evidence of *modification* or *redefinition* were observed.

A summary of Afnan's development is shown in Table 6-8.

Table 6-8. Summary of Afnan's development

SAMR Level	Description	Examples
Substitution	Used technology as a direct substitute for a traditional task, with no functional change	Employed PowerPoint presentation as a substitute for traditional chalkboard explanations, conveying matrix concepts concisely with clear explanations and examples, replicating a typical lecture format using technology
Augmentation	Used technology to enhance a task's effectiveness, adding some functional improvement	Augmented lesson using PowerPoint presentation to provide visual clarity through illustrations and examples involving mathematical equations
Modification	No evidence of this level in the lesson	No evidence of this level in the lesson
Redefinition	No evidence of this level in the lesson	No evidence of this level in the lesson

6.10.4 Summary of Journey

In Afnanh's lessons, she used technology to enhance task effectiveness, adding some functional improvement. Based on the SAMR model, her use of technology falls under the enhancement level.

Technological readiness and eagerness to embrace technology as an educational tool have marked Afnan's trajectory as a preservice teacher. Aided by the ETP, she

developed an understanding of pedagogy and a determination to ensure that she utilized technology to improve the experiences of her student.

6.11 Case Study – Sanaa

Sanaa is a pre-service teacher of Islamic Studies undertaking her PPE in a high school. In school, she received support from a university supervisor and school-based mentor-teacher for embedding technology into lessons.

She faced one significant challenge in this school: despite the availability of various technological tools in her school, school staff were reluctant to allow PSTs to use the school's network. Sanaa and her peers made sure to have mobile Wi-Fi available: "everything was available except Wi-Fi; the school staff did not allow us to use it."

Sanaa considered herself a technology novice, identifying where she had some knowledge and where she needed to upskill in technology-related competence to improve self-efficacy.

6.11.1 Initial Knowledge and Understanding

Sanaa felt reasonably confident in her technological abilities, having some knowledge in certain areas while acknowledging that she is not an expert in everything. She said: "I wanted from the beginning to use technology in education."

She self-evaluated as a beginner because: "I don't master all the technology tools well. I need more courses or practice to increase my knowledge of using technology."

Sanaa indicated that her self-efficacy in using technology played a significant role in her decision-making, stating: "when I feel confident in my tech skills, I am more likely to integrate technology into my teaching."

6.11.2 Development of Effective Teaching (TPACK)

Sanaa used PowerPoint and videos. She said: "If I couldn't find what I was looking for, I designed a simple video on TikTok." She used PowerPoint and video presentations to enhance her teaching methods, as she felt that she could engage students using visuals to help explain complex concepts effectively. This creativity in resource creation demonstrated a commitment to enhancing the learning experience for students.

Sanaa incorporated cooperative learning through the XO game, whose diverse resources and interactive tools enhance student engagement and make learning more enjoyable, to review grammar and vocabulary, as she explained:

> Students were divided into two groups. Group X and Group O. They start by choosing one of the questions with numbers, it consisted of nine questions and if she [the student] answered correctly, we pressed one click and the game continued until it ended with a group winning. (Sanaa, personal communication, Dec 22, 2021)

Sanaa employed technology for assessment by creating a quiz game as she believed a gamified approach made learning more interactive and enjoyable for the students.

She used WhatsApp as a communication tool to keep students informed about assignments and other important information. Additionally, she utilized digital tools, such as calendars and reminders, in order to stay organized (TK):

> I usually use WhatsApp to communicate with the students and inform them about everything I want from them, such as homework. I also use alarms, the calendar and Google Drive to arrange all of my documents and files. (Sanaa, personal communication, Dec 22, 2021)

In this context, Sanaa demonstrated her ability to use a variety of technological tools within the teaching context for communication and organisation. She further enriched the student learning experience by using tools such as the Spinning Wheel and XO. These interactive tools motivate students and make learning more enjoyable: “Such as a spinning wheel or XO game, students interact and get excited.”

Sanaa applying what did she learned in the PPE: “I used the Spinning wheel, PowerPoint and XO, which I learned for the first time in the field program.” This willingness to adapt enhanced her teaching methods.

Sanaa acknowledged that technology made her feel more comfortable and simplified various aspects of teaching: “from the beginning, I am ready to link technology with teaching; but I wanted to use technology in education in the real world.” This increased self-confidence likely contributed to her success in integrating technology effectively. As she stated: “it gave me confidence and motivated me to use technology in education.”

Furthermore, Sanaa outlined her future aspirations, stating: “I want to take courses that will help me learn more about the use of technology in my field in the future.” This forward-looking statement underscores her commitment to continuous learning and professional development, indicating her intention to further enhance her technological proficiency in the realm of education.

The next section will Demonstrate how technology tools are used in the classroom to enhance learning align with the different levels of technology integration proposed by SAMR.

6.11.3 Development of Effective Teaching (SAMR)

Sanaa’s observed lesson was about defining the monotheism of divinity, such as who is the Lord, what are His names and attributes and how people can worship. The lesson was delivered through a PowerPoint presentation in which she placed pictures from the textbook in the presentation slides, included the definition of monotheism, the types of monotheism and created tables to differentiate between the names and attributes of the One God. She also presented the Quranic verses were in pictures form. She asked the students to participate in the classification of the verses and to review the content of the lesson through the XO game displayed on the screen (see Figure 6-3). No evidence of modification or redefinition were observed.

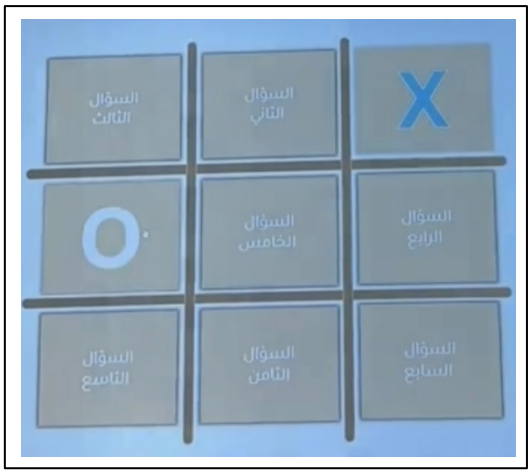

Figure 6-3. Example of XO game

Sanaa incorporated concept maps to allow students to connect the words to a central theme, finishing, the lesson with homework requirements.

There was no evidence of redefinition during the lesson.

A summary of Sanaa's development is shown in Table 6-9.

Table 6-9. Summary of Sanaa's development

SAMR Level	Description	Examples
Substitution	Used technology as a direct substitute for a traditional task with no functional change	Replaced traditional content with PowerPoint slides
Augmentation	Used technology to enhance the learning experience by adding improvements, but the core activity remained similar	Enhanced Quranic verses using digital presentations
Modification	No evidence of this level in the lesson	Added interactive elements and games such as concept maps and XO
Redefinition	No evidence of this level in the lesson	No evidence of this level in the lesson

6.11.4 Summary of Journey

Sanaa's use of technology in her teaching falls within the transformation level of the SAMR model. She used technology to redesign tasks, creating new possibilities not feasible without technology, as she added interactive elements such as XO games and concept maps.

Interestingly, Sanaa initially perceived herself as a novice in using technology for teaching at the beginning of the course. However, throughout her Professional Practice Experience (PPE), she exhibited a commendable commitment to learning and honing her technological expertise.

Her journey exemplified how she effectively addressed the challenges of integrating meaningful technology into education. It was clear that she recognised the need for more professional development and support to enhance her self-efficacy.

6.12 Case Study – Haia

Haia was a pre-service kindergarten teacher. She faced a significant challenge as she was unable to complete her Professional Practice Experience due to COVID-19, resulting in a modified university field application. This adaptation led to the utilization of technology to facilitate the teaching and learning process in a virtual setting.

Choosing and implementing technology in early childhood education must consider that not all technology is appropriate for kindergarten-aged children. In this transformed learning environment, Haia's university classmates assumed the roles of pupils, as she was unable to be assigned to a physical classroom. The virtual classroom setting presented its own set of challenges, particularly concerning the appropriateness of the technology used for kindergarten-aged children.

The technology chosen for this virtual classroom was thoughtfully selected to align with the educational needs and developmental stages of kindergarten-aged children. It prioritized simplicity, interactivity and child-friendly interfaces to create a positive and engaging learning experience.

Despite the careful selection of technology, Haia was aware of the potential challenges and concerns related to its use in early childhood education. Ensuring that the digital tools used were age-appropriate, encouraged active participation and facilitated meaningful interactions with the virtual pupils was crucial. She recognized that technology should complement, rather than replace, traditional teaching methods and be used judiciously to support children's development.

As Haia embarked on her teaching journey within the virtual classroom, a considerable part of her assessment focused on the comprehensibility of her explanations and the clarity of her presentations. She promptly provided her supervisor with feedback upon completing her evaluations, emphasizing how the technology used impacted her teaching strategies.

6.12.1 Initial Knowledge and Understanding

Haia regarded her use of educational technology as a novice and, committed to improve across the ETP and teaching experiences offered aspiring to develop expertise. Haia's acknowledgment of her existing proficiency and her commitment to continuous growth are promising signs for her future as an educator. Her statement, best encapsulated her self-perception and determination for improvement:

> I may be a beginner now, but my goal is to advance and become an expert. (Haia, personal communication, Dec 23, 2021)

When questioned about her technology proficiency, responding with "not bad", showing awareness of the need for improvement. Similarly, her "I guess" reply

regarding computer confidence underscored the ongoing importance of learning in educational technology. These replies indicate her recognition of the need for skill enhancement and the continuous refinement necessary to keep up with tech advancements in education.

As she aptly stated:

> By this we mean that the college courses and programs improved us through our use and application of them. (Haia, personal communication, Dec 23, 2021)

Her responses emphasized the vital role of ongoing such integration technology courses.

6.12.2 Development of Effective Teaching (TPACK)

Haia's approach to incorporating technology into her teaching reflected an understanding of the TPACK framework, as she described using various ICT tools (TK), such as PowerPoint presentations, videos and photos, to illustrate lessons (CK).

Haia indicated a willingness to adapt her teaching methods (PK) to accommodate ICT (TK) and expressed the intention to enhance student learning (CK) and interaction using PowerPoint presentations, videos and pictures. This adaptability aligned with the TPACK framework, where the video clips exposed children to realistic applications of the concept of Eid prayers and takbeers. In addition to making the content more relevant and interesting, this helps children learn how to apply their knowledge to real-world situations. Haia also used "number cards and sandpaper for writing" to contribute to an engaging and multisensory learning environment (PCK).

Haia's motivation for using technology included "personal factors, preparation for the future and the development and acquisition of skills." This motivation aligned with the core principles of TPACK, in which teachers seek to enhance their pedagogical and content knowledge through technology integration, ultimately aiming to provide clearer information to students in a more efficient and engaging manner.

Additionally, Haia's responses reflected an enhanced sense of readiness and increased self-efficacy in utilizing ICT for learning. When asked about their initial preparedness to use ICT at the completion of the course, Haia responded, "Now I have learned

more," indicating not only an acquisition of knowledge, but also a growing confidence in her abilities.

In response to the question about the change in her self-efficacy level concerning ICT, Haia provided further insight, stating, "Yes, because I had an experience and found it easier and more comfortable." This response highlighted a tangible improvement in her perceived self-efficacy, attributed to the hands-on experiences gained during the course and an increased comfort level with ICT tools.

The next section will Demonstrate how technology tools are used in the classroom to enhance learning align with the different levels of technology integration proposed by SAMR.

6.12.3 Development of Effective Teaching (SAMR)

This unit introduces students to Eid al-Fitr, a big holiday in Islamic culture that marks the close of Ramadan, which is a month where Muslims fast. From this location, the phrase "foundational aspects" implies that there is need to concentrate on major parts or basic elements of this celebration such as its cultural religious and traditional facets. This included explaining the basic customs and traditions associated with Eid al-Fitr. The lesson also aimed to impart knowledge about proper Eid etiquette.

In addition to learning through play activities, Haia incorporated tools, such as PowerPoint presentations and video clips, to enhance the learning experience. The overarching goal of Haia's lesson was to provide students with an engaging and informative learning experience. For instance, she used PowerPoint presentations including visual songs, actively involving the students in chanting and participation, thus leveraging technology as a supplementary tool to enrich their education.

There was no evidence of modification or redefinition during the lesson.

A summary of Haia's development is shown in Table 6-10.

Table 6-10. Summary of Haia's development

SAMR Level	Description	Examples
Substitution	Used technology as a direct substitute for a traditional task with no functional change	Employed PowerPoint presentation to explain the lesson, similar to traditional methods of using a chalkboard or handouts
Augmentation	Used technology to enhance the learning experience by adding	Introduced multimedia elements, such as Eid takbirat sound and

SAMR Level	Description	Examples
	improvements, but the core activity remained similar	video clips, enriching the lesson beyond traditional methods
Modification	No evidence of this level in the lesson	No evidence of this level in the lesson
Redefinition	No evidence of this level in the lesson	No evidence of this level in the lesson

Haia's teaching approach focussed on the augmentation level of the SAMR model, catering specifically to kindergarten students' developmental needs. Her emphasis remained on enhancing traditional teaching methods, while incorporating multimedia elements, such as Eid takbirat sounds and video clips, into PowerPoint presentations. Interactive tools such as number cards for writing contributed to an engaging and multisensory learning environment.

Despite not yet reaching the *modification* level of the SAMR model, Haia's approach effectively balanced technology use with the developmental stage of her kindergarten students, fostering a dynamic and age-appropriate learning environment.

6.12.4 Summary of Journey

Haia's use of technology falls under the enhancement levels based on the SAMR model, as she added value by utilising technology, making it more engaging and interactive than traditional approaches.

While the virtual setting enabled her to adapt and continue her education during these challenging times, the absence of actual children in the classroom was a limitation. This limitation restricted her ability to practice and develop vital skills such as classroom management and effective interaction with children.

Overall, Haia's experience underscores the importance of thoughtfully integrating technology into early childhood education, ensuring it meets the unique needs of kindergarten-aged children and supports their holistic development.

6.13 Chapter Summary

Nine pre-service teachers were interviewed and observed during their teaching sessions after completing the ETP. The aims of the case studies were to observe their practices in using technology to teach in order to determine:

- How the pre-service teachers perceived their level of self-efficacy and to demonstrate their knowledge of the TPACK and SAMR constructs.
- How that knowledge related to their self-efficacy.
- How they incorporated technology in their teaching.
- Role technology played in their teaching.
- Contexts that affected their use of technology.

The pre-service teachers who participated in the study demonstrated increased levels of Knowledge of TPACK and SAMR frameworks was core to the ETP, with six participants achieving SAMR Enhancement level and three achieving SAMR Transformation level, indicating that they understood the constructs and were capable of applying the TPACK and SAMR frameworks in planning and teaching. The preservice teachers unanimously agreed that the majority of their technology-related knowledge was self-acquired. Prior to undertaking the ETP course, they received limited formal training in utilizing technology during their initial teacher education programs.

According to the preservice teachers, they often supplemented their formal education by exchanging experiences, learning from peers and receiving guidance from mentors and supervisors. As the pre-service teachers observed, technology played a pivotal role in enhancing student engagement and fostering a deeper understanding of academic concepts.

Pre-service teachers harnessed the concepts of Technological Pedagogical Content Knowledge (TPACK) and the Substitution, Augmentation, Modification, Redefinition (SAMR) model to develop more effective teaching strategies. This integration of technology effectively aligned with their Technological Knowledge (TK), Pedagogical Knowledge (PK) and Content Knowledge (CK).

According to pre-service teacher perspectives, technology:

- Significantly bolstered teaching effectiveness.
- Resulted in heightened student engagement.
- Improved comprehension of concepts.
- Provided opportunities for students to extend their learning beyond the classroom.

This synergy reflected the combined influence of TK, PK and CK.

Table 6-11 summarises integration of TPACK and SAMR model. Note that for the SAMR model, *Redefinition* has been omitted as no PSTs reached this level.

Table 6-11. Summary of TPACK and SAMR integration

	SAMR (R not shown)		
TPACK	**Substitution**	**Augmentation**	**Modification**
TK	All demonstrated transition from using traditional chalkboards to PowerPoint. Only PST5 completely replaced paper-based homework with digital platform. Five utilized WhatsApp for scheduling, sending and receiving homework tasks	All enhanced teaching with technology, incorporating videos, interactive resources and utilizing tools, such as CleverEnf and PowerPoint to create engaging educational materials. PST3 integrated videos into presentations for virtual mixing	PST1 included special games and quick feedback to enhance engagement. PST5's students used WhatsApp to share their work
PK		All engaged students visually by enhancing lessons with interactive resources, using visuals and animations to explain complex concepts. By creating interactive and adaptive instructional materials, provided functional improvements, combined theory with practice using interactive exercises. Enriched lessons with multimedia and interactive tools, surpassing traditional teaching methods.	Utilized a cooperative learning strategy with technology. PST (PST1, 5 and 8)
CK		All of the PSTs used PowerPoint to enhance their lessons.	PST5 delivered personalised and engaging learning experiences using CleverEnf®

			PST8 used Concept maps and XO games to enhance learning

As presented in the case studies in this chapter, nine pre-service teachers indicated that technology was regularly used to support student learning and teaching. To enhance student understanding, all PST teachers explored, elaborated and demonstrated concepts with ICT tools. WhatsApp was used by five pre-service teachers to communicate with one another and share student work. Although the use of WhatsApp tools to facilitate student discussion and is an informal complement to the Madrasati program, the WhatsApp played a major role in endeavours to increase student engagement, to help students understand concepts and to provide opportunities for students to learn outside the classroom.

In the following chapter, the case studies presented will be compared with the quantitative results obtained from the Teachers' Sense of Efficacy Scale (TSES) (as discussed in Chapter 5). This comparative analysis aims to explore the potential relationship between pre-service teachers' experiences with technology integration and their self-perceived efficacy. By examining these findings, I seek to illuminate the complex dynamics at play and identify potential correlations between technology integration practices and teacher self-perception.

7. Analysis of Influences on Technology Integration

This chapter consists of the following sections:

- Introduction
- Research Overview
- Perceptions of Technology-Related Self-efficacy
- Effects of Learning on Perceptions of Self-efficacy
- Self-efficacy and Use of Technology
- Factors Shaping Use of Technology
- Chapter Summary

7.1 Introduction

The findings of the self-efficacy analysis which explored the possibility of integrating digital technologies effectively into preservice teacher education practice in Saudi Arabia were presented in Chapters 5. Chapter 6 contained case studies of pre-service teachers (PSTs).

In this chapter, a mixed-method approach exploration of the technology integration for PSTs and their classroom practice is discussed in detail.

7.2 Research Overview

The main objective of this research was to explore the possibility of integrating educational technologies smoothly into the curricula of teaching pre-service teachers in the Kingdom of Saudi Arabia.

The research questions (Section 1.7) for this study are:

- Do Saudi pre-service teachers perceive they have sufficient levels of knowledge, experience and self-efficacy to be classroom-ready to teach with technology? (RQ1)
- How do Saudi pre-service teachers adapt the use of technology in their classroom through participation in educational technology programs (ETP) and professional placement experience (PPE)? (RQ2)

- Does Saudi pre-service teachers' self-efficacy change through their participation in an ETP & PPE? What drives this change? If not, what are the potential reasons for this? (RQ3)

This research aimed to tackle the lack of knowledge and experience in technological self-efficacy among pre-service teachers, mainly in dealing with the recent decision of the Saudi Arabian government is striving to involve the modern teaching technologies and integrate them in the curriculum. The Saudi Arabian literature indicated a deficiency in teacher preparation and training concerning the use of digital technologies to enhance student learning, emphasizing the need for enhancements in this aspect (Alqurashi et al., 2017; Alshehri, 2012; Oyaid, 2009,; Alhababi, 2017; Alnajjar and Al-Jamal2019; Alblaihed, 2016; AlTurki, 2015; Alzahrani, 2011; Alabdullatif, 2019; Alseghayer, 2022; Alshawaf, 2021). To address these deficiencies in teacher education, a course was developed to increase the level of knowledge and application of digital technologies in teaching and self-efficacy in pre-service teachers.

This study was developed to assess the impact of this course. The study used a mixed-method design including survey tests, semi-structured interviews and observation.

A survey questionnaire was conducted at the beginning of the Educational Technology Programme (ETP) and again at the end to evaluate the change in the self-efficacy of Saudi pre-service teachers (Chapter 5). Following completion of the ETP, observations of micro-teaching of teachers were conducted, followed up with semi-structured interviews to confirm, enrich and more fully understand their experiences and self-beliefs. The case studies provide a richer and deeper understanding of the results of the survey and can support development of training for teachers in the use of digital technology.

The key theoretical frameworks, TPACK and SAMR, were strategically combined to act as lenses for analysing how Saudi pre-service teachers integrated technology into their lessons. These frameworks guided the formulation of practically relevant recommendations derived from a contextual perspective.

For this study, a self-efficacy perspective revolved around beliefs of pre-service teachers in their own abilities to use technology effectively in the classroom. In this context, self-efficacy encompasses confidence, competence and perceived capabilities

in integrating technology into teaching practices. This perspective explored psychological aspects of technology integration and how self-efficacy influenced the extent to which technology could be employed effectively in the teaching and learning process.

Using TPACK and SAMR together led to a broader perspective of the technology integration in education by investigating interdisciplinary knowledge (TPACK) and of deeper technology integration levels (SAMR), as well as providing insights into self-efficacy of pre-service teachers.

This remainder of this chapter details the key trends and patterns that were observed.

7.3 Perceptions of Technology-Related Self-efficacy

This section examines perceptions of technology-related self-efficacy of pre-service teachers. The section relates to research question 1 (RQ1).

Results (Chapter 5) show that most pre-service teachers had high levels of confidence in their abilities to integrate ICT into their teaching and were generally prepared to integrate computer technology in teaching. Specific instruments were adopted to ascertain their self-efficacy according to the following factors (Section 5.3.9):

1 Efficacy in classroom management and engagement.

2 Efficacy in instructional strategies.

3 Efficacy in technology integration.

Saudi preservice teachers demonstrated a strong sense of self-efficacy in instructional strategies and the integration of technology, showing a high level of confidence and readiness in employing effective teaching methods and incorporating technology into their instructional practices. The PSTs' self-efficacy in using technology to enhance student engagement and classroom management is clear from the mean score of 5.94 however, there is a measure of inconsistency as they may not have the same level of confidence. This interpretation may mean they are moderately prepared, but the qualitative examination unveiled subtleties as to teachers' confidence in classroom management and engagement with students as they use technology. Lamia shared that technology led her students to be more involved and happier. Iasmin emphasised the point of technology in terms of planning, time management and financial aspect, so

that teachers can easily convey the material to students. Afnan stated that technology had helped in time management which led to her getting complimented by bosses and urged to use technology. These discrepancies showcase the complexity of embracing technology in education and emphasise the need for pursuing more studies on teachers' experiences and attitudes to provide necessary training and support. Overall, the results revealed that in all areas, Saudi preservice teachers fell within the range of responses categorized between "some influence" and "quite a bit".

These findings are important for understanding how the PSTs viewed their self-efficacy in using instructional methods, integrating technology, managing classrooms and involving the learners. The quantitative findings also indicated that the Saudi pre-service teacher participants exhibited diverse levels of knowledge, experience and self-efficacy in the areas of Efficacy in Instructional Strategies and Efficacy in Use of Technologies Integration. In addition, the findings indicated that some PST participants demonstrated strong confidence and zeal towards using technology in their instruction. While other participants exhibited only moderate confidence. The variations in self-efficacy levels may be influenced by the individual's past experiences and training. This viewing sets the stage for a deeper exploration of the factors that contribute to pre-service teachers' attitudes towards technology integration, which will be discussed in more detail later in this section/chapter.

These findings align with Al-Zahrani (2011), who emphasized that Saudi pre-service teachers, when assessed, were highly motivated and possessed a strong belief in their capacity to effectively incorporate technology into their learning approaches.

Furthermore, the current research supports the concept of experiential learning and pre-course knowledge as the most important factors that can influence the educator outcomes. Despite this, two thirds of pre-service teachers revealed that basic preparation for technology integration was not enough before enrolling into the Educational Technology Programme (ETP) which could lead to a lack of creativity in the development of education pedagogies. For the participants in this study, six (of nine) described themselves as novices in technology, grappling with a lack of ability to effectively incorporate technology into their teaching practices to facilitate more student-centred learning. Furthermore, pre-service teachers were limited in their explorations of technology's transformative potential by practical constraints and

limited access to technological resources such as limited USB cables and unreliable internet connections, which hindered their access to technological resources.

Prior research emphasized the impact of inadequate preparation on the integration of Content Knowledge (CK), Pedagogical Knowledge (PK) and Technological Knowledge (TK) on technology usage in teaching (Tunjera & Chigona, 2020).

Studies conducted involving Saudi PSTs (Al-Abdullatif, 2019; Al-Seghayer, 2022) presented a different perspective. Findings in Al-Abdullatif (2019) suggested that Saudi pre-service teachers may not perceive themselves as adequately equipped to teach with technology. In the current study as well the participants showed limited knowledge and skills in using technology for teaching purposes such as... “I did not have enough knowledge and skills in technology integration” .... “Limited skills, switched to using presentations (PowerPoint)” ....”felt insufficient in terms of integration ICT”..”I need more courses or practice to increase my knowledge of using technology”. Similarly, Al-Seghayer (2022) highlighted low self-efficacy among English as Foreign Language (EFL) teachers regarding technological knowledge and pedagogical technology skills, noting that “the findings...revealed that Saudi EFL teachers have low self-efficacy” (p. 1).

In contrast, PST self-efficacy increased after technology experience ETP as presented in table 36 “After collaborating with colleagues during a course, I acquired expertise in using projectors, smart screens and various methods”. “Satisfied with improved skills” “After engaging in peers, discovered new tools such as Canva, significantly improving integration into educational practices”. “Satisfied with transformation “I benefited from a course, learned to use the Nearpod program and applied the TPACK theory in lesson design. I became more educated and knowledgeable about the subject.”. According to Thohir et al. (2023), pre-service teachers perceived themselves as well prepared to integrate technology when given opportunities and training, with both skill levels and understanding increasing after gaining experience with technology. Supporting this observation, Tunjera and Chigona (2020) highlighted that while many teacher educators used technology, this use is predominantly at lower levels (such as substitution and augmentation from the SAMR model). This suggested that although technology is present in classrooms, its full integration into teaching practices may not be realized, further suggesting that pre-service teachers focus on using technology to benefit the teacher rather than the

learner, such six participants (which showed the enhancement level in SAMR) transitioned from traditional chalkboards to PowerPoint, integrated multimedia resources for visual engagement, showing teachers-centred ways of providing instructions and involving students (See section 6.1.3). Furthermore, it is possible that these approaches may be due to PSTs having felt inadequately prepared to integrate technology into their future classrooms. Tunjera and Chigona's (2020, p. 2), reported that "studies have revealed that pre-service teachers feel inadequately prepared to integrate technology in their future classrooms" further reinforcing the notion that PSTs believed they lacked preparation.

Perceptions of a lack of adequate preparation by PSTs may not reflect the reality of their actual preparedness. Schmid, et al. (2021) argued that while pre-service teachers may have some level of knowledge and self-efficacy in TPACK, their self-reported levels may not align with their actual readiness to teach with technology. The combination of TPACK components may not directly influence technology integration in teaching if where low-skilled individuals tend to overestimate their abilities (Dunning, 2011; Kruger & Dunning, 1999). Therefore, the perception by pre-service teachers of levels of TPACK may not accurately reflect their actual readiness to teach with technology.

Interestingly, three (of nine) PSTs in this study viewed their own progress from the enhancement phase through to the transformational phase as *gaining* confidence as competent technology users. This transition allowed them to recognize technology's power in redefining the education process, particularly at the *modifying* stage of the SAMR model, in which technology transforms teaching and learning. As noted previously, these findings suggest that attitudes and preparedness for technology integration of pre-service teachers vary based on their exposure, experiences and self-perceptions. As highlighted in the case studies of Ahlam and Aqbal (Sections 6.5 and 6.7), skill discrepancies among pre-service teachers necessitated focused skill development efforts. Sanaa's recognition of the need for more courses and practice (Section 6.11) aligned with the findings of broader studies on technology integration in education (Almaiah et al., 2020). Aisha and Afnanh's lack of experience with technology (Sections 6.6 and 6.10) was reflected in studies addressing the aversion to technology by educators (Al-Abdullatif, 2019).

Pre-service teachers in this study encountered various challenges when integrating technology, such as limited access to technology, insufficient training and skill discrepancies, which hindered effective integration of technology into teaching methodologies. Al-Abdullatif (2019) highlighted the struggles faced by PSTs stemming from a lack of attention to appropriate technology use and a failure to emphasize its potential for enhancing student cooperation and learning. This aligned with the experiences reported by Ahood (Section 6.8), who faced limited access to projectors and HD cables, hindering her creative efforts and emphasized the challenge posed by the absence of open internet access.

The difficulties Lamia (Section 6.4) as a computer field specialist in her school where there is no computer science teacher create echoes of bigger problems as exposed in studies such as Bozkurt et al. (2020). The studies portray the deep significance on the students, manifesting the limitations of social and academic exchanges which occur in the schools of the Kingdom. Bozkurt et al. (2020) explained how students dealt with a lack of appropriate technological integration which in turn make the consequences of this inadequacy felt more acutely.

These challenges also extend to struggling to see the link with mentoring and resources, as outlined by Alammary et al. (2022) and Almaiah et al. (2020), who identified factors such as inadequate access to technology, limited training opportunities and time constraints.

Challenges faced by pre-service teachers in integrating technology into their teaching methodologies are substantiated in existing literature, which collectively emphasize imperatives for improving access to technology, providing mentorship and offering ongoing professional development to empower pre-service teachers in navigating the complexities of technology integration including works (Al-Abdullatif, 2019; Bozkurt et al., 2020; Alammary et al.,2022; Almaiah et al., 2020).

These findings align with the idea (Kilty & Burrows, 2021) that pre-service teachers often encounter difficulties in using technology effectively due to barriers, such as lack of prior knowledge and experience and that schools may also lack resources for technology integration, compounding the challenges faced by pre-service teachers. However, a notable shift occurred when pre-service teachers were provided with opportunities to gain hands-on experience with technology. This aligned the findings of Thohir et al. (2023) that underscored the importance of practical experience and

training in enhancing pre-service teachers' skills and confidence in technology integration. Moreover, an acknowledgment that pre-service teachers showed increased skill levels and understanding of technology through practice (Chittleborough, 2014; Means & Olson, 1994; Zacharias, 2003) supported the transformative potential of experiential learning. This suggests that providing access to technology and structured opportunities for practice can bridge the gap between initial readiness and effective integration of Content Knowledge (CK), Pedagogical Knowledge (PK) and Technological Knowledge (TK).

From the nuanced picture of pre-service teachers' technological preparedness revealed in these various studies, it became evident that comprehensive pre-service teacher preparation programs and targeted professional development are essential and most effective with associated practical experience. Providing discipline-specific training such ETP that supports content knowledge, pedagogical knowledge and technology tools knowledge along with SAMR-specific methodology can provide a more structured approach to the optimal way to integrate technology by cooperation and managed classroom dynamics effectively.

Findings regarding self-efficacy, as seen in studies by Al-Seghayer (2022) and Thohir et al. (2023), reinforced the psychological aspect of technology integration. Teachers' beliefs in their abilities play a pivotal role in determining their approach to incorporating technology into teaching practice. Hence, professional development programs should not only focus on technical skills, but also address development of teachers' confidence in utilizing technology effectively.

Furthermore, acknowledgment of potential overestimation of self-reported technological knowledge, as indicated by Schmid et al. (2021), necessitate a more nuanced approach to assessing teacher readiness, aligning with the idea that self-perceived levels of Technological Pedagogical Content Knowledge (TPACK) may not always align with the actual capabilities of pre-service teachers. Therefore, evaluations and support mechanisms should be designed to provide accurate assessments and targeted interventions.

7.4 Effects of Learning on Perceptions of Self-efficacy

This section examines effects of educational technology learning and application on the perceptions of self-efficacy of pre-service teachers' perceptions. The section relates to research question 2 (RQ2).

One of the important factors in professional development is the need to emphasize the importance of continuous support throughout the career of a pre-service teacher (Chitiyo & Brinda, 2018).This naturally involves pre-service teachers staying updated with new technological tools and continuously improving their skills to adapt, as mentioned by participants: " After engaging with peer [mean in ETP] I discovered new tools such as Canva, significantly improving integration into educational practices",

"I benefited from a course [mean ETP], learned to use the Nearpod program and applied the TPACK theory in lesson design" and learning new tools "The XO game, which I first learned about in the ETP" "After the end of the program, I feel ready to teach more so I am on my way to the best, such as doing electronic tests and the method of teaching English", "So, it is important to develop ourselves from time to time and be updated" as previously noted studies confirm (Kartal et al. in 2021; Koh & Chai, 2011; Tondeur et al., 2017; Valtonen et al., 2017; Zimmermann 2021). Especially those that highlight the positive impact of experience and continuous training (Al-Abdullatif, 2019; Almaiah et al., 2020; Gudmundsdottir & Hatlevik, 2018; Kilty & Burrows, 2021; Starkey, 2020; Thohir et al., 2023; Tunjera and Chigona, 2020), because of the benefits in improving and growing for technology readiness in the pre-service stage. Moreover, disparities observed among pre-service teachers in different disciplines, as indicated by Saltan and Arslan (2017), suggest that tailored approaches are necessary.

Discipline-specific training can address the unique challenges and requirements associated with integrating technology into various subjects, ensuring that teachers are adequately prepared within the context of their specific educational domains. Exploration of research question 2 (RQ2) analysed shifts in pre-service teachers self-perceived efficacy following their engagement in the ETP course.

The quantitative results in Section 5.5 offer a comprehensive overview of the collective impact on the participants in this study. Firstly, Factor 1: Efficacy in

Classroom Management and Student Engagement This difference underscores the program's effectiveness, leveraging technology to build student confidence in academic success, instilling the value of learning, controlling behaviour within the classroom and managing unruly students.

Furthermore, qualitative findings supplement these quantitative results. For instance, Doha implemented a new application to facilitate English learning for her students, while Lamia employed alternative strategies to simplify complex topics. Ahlam utilized technology to enhance engagement, Afnan incorporated it to broaden students' knowledge and Aqbal effectively used ICT tools to maintain student focus, aligning with the objectives of Factor 1. PST highlighting the importance of employing alternative teaching strategies to simplify complex topics and increasing student engagement. Integrating technology into teaching purpose can enhance student engagement and learning outcomes (Williams-Buffonge, 2021; Akram et al., 2021; Drajati et al., 2021). In fact, PST's effective use of ICT tools to maintain student focus corresponds to recommendations from the ETP regarding classroom management techniques. These actions reflect the integration of ETP principles into practice, as teachers utilize various strategies to enhance student engagement & management.

The results of this study highlight something different from previous studies, which is that the first factor in the TSES questionnaire, which focuses on student engagement and classroom management, can be related to the technological content knowledge in the TPACK model. Pre-service teachers here at this level use technology to control the class and interact with the topics and content of the lesson to facilitate and simplify complexity.

Similarly, the quantitative results also confirm the intervention's effectiveness in Factor 2: Efficacy in Instructional Strategies. This includes implementing alternative strategies, encouraging student cooperation and establishing classroom management and evaluation systems. Ahlam, Ahood and Sanaa exemplified this through cooperative learning methods and leveraging technology tools such as WhatsApp and the XO game to foster collaborative learning environments, German studies also found that professional development programs specifically focused on integrating technology in teaching could enhance PST technological pedagogical content knowledge (TPACK) (Zimmermann, 2021). Whereas the second factor in the TSES

questionnaire in this study is instructional strategies, which focuses on technological applications related to teaching strategies, which is called Pedagogical content knowledge in the TPACK model.

However, despite these advancements, there remains marginal progress in Factor 3: Efficacy in Technology Integration, particularly in achieving a learner-centred approach. While participants have shown an increase in their competence in utilizing technology for educational practices, the paired sample analysis suggests limited improvement in their awareness of technology's potential for enhancing teaching and facilitating learner-centred instruction. Qualitative results further support this point. For example, Iasmin, Afnanh, Aqbal, Haia and Aisha introduced multimedia elements, such as sound and visual aids, which enriched the lesson but still largely relied on teacher-centred approaches. Similarly, while Sanaa and Lamia's utilization of special games such as Wordwall and the XO game through technology does align with a learner-centred approach, their efforts represent only a minority among the participants. With only two out of nine participants demonstrating such approaches, there is a clear need for greater emphasis on integrating technology in ways that empower learners and foster greater autonomy in their learning experiences, aligning more closely with the objectives of Factor 3: Efficacy in Technology Integration.

Overall, while effective classroom management and the use of alternative strategies were evident, the integration of technology for enhancing student learning was less pronounced. Both quantitative and qualitative data revealed pre-service teachers' inclination towards using technology for administrative tasks and educational strategies, highlighting the need for a shift towards learner-centric approaches in technology integration.

Exploration of research question 2 (RQ2) analysed shifts in pre-service teachers self-perceived efficacy following their engagement in the program. The results of this analysis, presented in the Table 7-1, offer a comprehensive overview of the collective impact on the participants in this study.

Table 7-1 lists the pre-service teacher in order of code (PST1, PST2, …) with pseudonym (used in Chapter 6) and area of specialization. Each teacher has two mean values recorded for each of three factors, a mean value for before the ETP (Time 1) and a value for after (Time 2). Notably, PST3, PST9, PST10, PST11 and PST12 are

missing mean values for Time 2. This absence is due to three of them participating in personal observations and interviews but not completing the post-questionnaire, while the remaining did not participate in the observations and interviews.". The factors are (Section 5.3.9):

1 Efficacy in classroom management and engagement.

2 Efficacy in instructional strategies.

3 Efficacy in technology integration.

Table 7-1. Self-efficacy before and after ETP

Pseudonym (code) Specialisation		Factor (Mean)		
	Time	1	2	3
Lamia (PST1)	1	8.00	5.75	7.67
ICT	2	6.75	8.25	7.67
Aqbal (PST2)	1	5.25	4.25	3.00
Chemistry	2	5.50	5.75	6.67
Ahlam (PST4)	1	2.50	4.50	2.67
Islamic studies	2	5.00	6.00	4.67
Ahood (PST5)	1	4.75	4.00	6.33
Islamic studies	2	7.25	8.00	8.00
Iasmin (PST6)	1	8.25	7.00	7.00
Islamic studies	2	8.00	7.50	9.00
Afnanh (PST7)	1	5.00	6.25	7.67
Mathematics	2	8.00	7.50	8.33
Sanaa (PST8)	1	5.50	5.50	5.67
English	2	8.25	6.75	7.00

There is discernible variability in the results across the group. Of the nine pre-service teachers who actively participated in the technology-based programme (PST1), (PST2), (PST4), (PST5), (PST6) ,), (PST7) and (PST8) , significant improvements were observed in their technological integration, specifically based on the SAMR level criteria. For instance, Lamia, Ahood and Sanaa have already achieved a certain level of technology proficiency which is proved by their transformational level achievements. Nevertheless, their answers also indicate that although they have a general knowledge of technology and skills, they lack real-life practice or certainty in a certain area. Prominently, one-third of the participants attained transformative level in which they surprisingly innovated the application of technology to the environment

created for teaching (Altun, 2007; Smith & Kelley, 2007; Smolin & Lawless, 2007). These implications show correspondence with qualitative data, which proves the importance of going beyond the plain tools and considering creative ideas to integrate technologies into teaching, as suggested by works of Culp et al. (2005), Lessen & Sorensen (2006) and Robertson et al. (2007). By doing so, pre-service teachers can better prepare for the challenges of digital societies and meet the evolving needs of modern education.

While the other groups showed that 6 out of 9 surveyed students have achieved the reinforcement level, indicating that Saudi PSTs have a wide use of traditional technology education that mainly focused on basic tools such as PowerPoint (Robertson & Al-Zahrani, 2012). This may be reflecting of a lack of sufficient information or policy support regarding technology integration in the PST education curriculum in Saudi Arabia.

Lamia, for example, acknowledges that despite her specialization in the computer field, she initially lacked knowledge of operating a smart screen device “Specializing in the computer field, I lacked knowledge of operating a smart screen device at the beginning of the application. While Ahood values technology and considers herself to be at the high level of technology usage, she finds it difficult to integrate it properly “I had a good level of technology usage but felt insufficient in terms of integration”. This implies that although she is good in using technology for simple tasks, she ascertains the relevance of technology as part of her lessons or work. Sanaa stresses the need to take further courses or practice even more to get more knowledge and confidence in using technology. She agrees that her familiarity with technology determines how smoothly she can use innovative ways in her teaching “When I feel confident in my tech skills, I am more likely to integrate technology into my teaching”.

Lamia, Ahood and Sanaa’s acknowledgment of specific areas where they initially lacked expertise or confidence suggests that their transformational level was not solely achieved through past experiences but also through a willingness to adapt, learn and improve their skills. Their reflections demonstrate a growth mindset, which is essential for continued development in the rapidly evolving field of technology. Therefore, while their backgrounds in technology may have played a significant role

in their achievements, their openness to learning and refining their skills likely contributed equally to their success at the transformational level.

Through the realisation that they did not have initial competency or expertise in certain fields, Lamia, Ahood and Sanaa made it clear that their transformational level can also be ascribed to their willingness to adapt, learn from others and develop new skills. Hence, the technical knowledge of PSTs might have been a main factor of their performance at the transformational level but their openness to learning and strengthening their skill set have surely contributed to it too.

The distribution of the mean scores among the two groups is purposely contrasted and there are obvious variations. On the other hand, the average score of both time 1 and time 2 seemed higher for Group 1, consisting of Lamia, Ahood and Sanaa, than for Group 2 (Aqbal, Ahlam, Iasmin and Afnanh). The major stumbling block in the second group experience was the technological concept and ability limitations showing that there was a need for interventions specifically targeting confidence and baseline problems as revealed in the study carried out by Hamilton et al (2016). Also, analysis of the work done by Bosch, Mentz and Reitsma (2019) and Geer et al (2017) justified this finding.

The combined impact of Professional Placement Experience and the Educational Technology Programme resulted in substantial advancements for participants in terms of their self-efficacy. Participants showcased refined instructional strategies, improvements in classroom management and student engagement and a proficiency in integrating technologies into their teaching practices. These improvements underscore the value of integrating practical experience with targeted educational programs, providing educators with a well-rounded skill set for their continued professional advancement.

In this case, the findings of Schmid et al. (2021) are presented to support the hypothesis that pre-service teachers often overestimate their self-reported technological knowledge, which is linked to the difficulties in this research design. This alignment explains why more in-depth examination of teacher's readiness is paramount.

The results of the qualitative analysis also underscore that teachers PST1, PST5 and PST8 achieved the transformative level within the SAMR framework in their

integration of technology into teaching practices. The approaches of these teachers involve not merely enhancing but transforming traditional teaching methods with technology. This transformation includes the incorporation of multimedia elements or additional functionalities to substantially improve engagement and enhance the overall learning experience. In-depth insights from the qualitative data shed light on the nuanced ways in which educators such as PST1, PST5 and PST8 successfully reached the transformative level, showcasing a profound and innovative adaptation of their teaching methods through technology. This granular examination not only underscores the heterogeneity among the PSTs but also provides valuable insights into the specific areas where the technology-based programme had varying degrees of impact.

This increase in self-efficacy, however, was because of several factors and drivers of change. It appeared that the course content as well as hands-on training contributed greatly to giving PSTs useful knowledge and skills in how to successfully integrate technology. The course supported knowledge exchange through peer interactions and collaborative learning experiences further augmenting self-efficacy. Similar to other researchers, these results show that PSTs need to receive adequate training in a team environment in order to feel competent about their skills. As the studies collectively stress the role of experiential learning in enhancing pre-service teachers' technological competence.

The insights from Chittleborough (2014) and Zacharias (2003) highlighted that the integration of technology into pre-service teacher education programs should go beyond theoretical understanding. Offering opportunities for practical application and hands-on experiences can bridge the gap between theoretical knowledge and effective implementation in the classroom.

7.5 Self-efficacy and Use of Technology

The factors assessed in this study (Section 5.3.9) are:

1 Efficacy in classroom management and engagement.

2 Efficacy in instructional strategies.

3 Efficacy in technology integration.

Quantitative results highlighted a sizeable and statistically relevant impact on the advancement of competencies for pre-service teachers in one of the factors measured: efficacy in classroom management and student engagement (Factor 1). This effect not only reached statistical significance, but also implied a considerable impact, evinced by positive changes in the areas targeted.

The impact became apparent when examining the competence of pre-service teachers in implementing teaching strategies (Factor 2), which measured clearly and openly the change in the competence of future teacher practitioners in using teaching processes. It seems that this change implies obvious progress in their capacity to learn and use an array of teaching practices. On the other hand, a quantitative analysis of Factor 3 revealed no statistical significance since there is no meaningful variation. Although they were pre-service teachers who participated in an educational setting focused on technological advancements, the measured outcomes did not show a statistically significant change towards improving technology integration. It should be noted, however, that there could have been factors that limited their technology integration that cannot be measured due to the lack of a control group, as previously stated as a limitation of this study (Section 5.7.1).

Further investigation and analysis of teacher practices could reveal what drives such divergent results. Synthesis of quantitative and qualitative findings offers a nuanced understanding of the impact of the intervention on pre-service teachers' self-efficacy. The substantial effect size observed in Factor 1 strongly aligns with the qualitative evidence. The study indicates that despite the integration of PST perceptions and their emphasis on Content Knowledge (CK) and Pedagogical Knowledge (PK) over Technological Knowledge (TK), the prevalent use of PowerPoint remained the dominant technology among the majority of pre-service teachers. This is in line with Aniq and Drajati (2019) who found that while pre-service teachers possess fundamental technological skills, they were not adept at leveraging technology for instructional purposes. This divergence between awareness of the importance of technology and its actual utilization suggests a potential gap arising from a lack of confidence and experience in incorporating technology into instructional practices (Aniq & Drajati, 2019). This alignment of quantitative and qualitative data implies that the intervention significantly enhanced self-efficacy in areas closely associated with classroom management and student engagement. Although such enhancement

may serve to fortify existing proficiency in PowerPoint usage, it also underscores the need for targeted interventions to bridge the gap between the recognized importance of technology by PSTs and their actual utilization in teaching contexts.

The moderate effect size in Factor 2 (self-efficacy in instructional strategies) introduced a complementary layer. Qualitative insights revealed that PSTs recognize a discernible gap in their technological instructional strategies, as also noted in Aniq and Drajati (2019). The moderate effect size signifies meaningful progress in self-efficacy for instructional strategies, indicating advancement, albeit not as pronounced as those seen in Factor 1.

Despite the framework's guidance, Tunjera and Chigona (2020) revealed that pre-service teachers often struggle to integrate all three domains into their teaching practices, leading to limited strategies and a prevalence of teacher-centred traditional approaches.

In this study, Factor 3 (efficacy in technology integration) exhibited no statistically significant effect, emphasizing the challenge pre-service teachers face in incorporating various technologies into their teaching practices. This is consistent with qualitative observations that, despite proficiency in certain tools such as PowerPoint, pre-service teachers may still be distant from a broader array of technologies conducive to developing diverse teaching strategies. Notably, only three out of the nine participants utilized technology in a transformative manner to enhance student learning or to promote student-centred education (Johnson & Smith, 2021). This underscores the need for further exploration and support to enable pre-service teachers to integrate a wider range of technologies effectively for more innovative and student-centric teaching practices.

In summary, the study showcases a substantial impact on self-efficacy related to classroom management and student engagement, supported by the prevalent use of PowerPoint. The moderate effect size in instructional strategies indicates progress in addressing identified needs. However, the lack of a significant impact in technology integration implies that pre-service teachers might still be somewhat removed from a comprehensive range of technologies for cultivating diverse teaching strategies. These nuanced findings underscore the necessity for targeted interventions to bridge identified gaps and foster a more holistic enhancement of self-efficacy.

Qualitative findings revealed a common theme among PSTs as they embarked on their individual journeys towards technology integration. Initially, the majority lacked substantial experience in teaching with technology, with a notable exception being the prevalent use of PowerPoint. Recognizing the imperative need to cultivate technological teaching skills, PSTs acknowledged a gap that required addressing before the implementation of their courses.

7.6 Factors Shaping Use of Technology

Findings from the qualitative phase of the research highlight the importance of several factors in shaping pre-service teacher attitudes toward using technology to support teaching their students.

Some PSTs overtly noted the impact of learning from the ETP course, while others evidenced learning through their actions and pedagogical choices in the PPE. Table 8-1 summarizes these findings, which are then discussed in further detail.

Table 8-1. Initial familiarity with technology

Before program	After program	Aids to learning
I did not have enough knowledge and skills in technology integration. I knew PowerPoint superficially	After working with peers during field training, I gained in-depth knowledge of PowerPoint and became proficient in its use.	Collaborating with peer in ETP
Specializing in the computer field, I lacked knowledge of operating a smart screen device at the beginning of the placement. “I’m almost an expert”	After collaborating with colleagues during a course, I acquired expertise in using projectors, smart screens and various methods. Satisfied with improved skills	Collaborating with peer in ETP; positive attitudes
I had a good level of technology usage but felt insufficient in terms of integration ICT	After engaging in peers, discovered new tools such as Canva, significantly improving integration into educational practices. Satisfied with transformation. “For me, I have not benefited from the ETP at the time with cyclical pressure”	Collaborating with peer in ETP
Realized limited skills in teaching math, switched to using presentations (PowerPoint)	“I benefited from a course, learned to use the Nearpod program and applied the TPACK theory in lesson design. I became more educated and knowledgeable about the subject.” Used technology in the education process. Recognized by the supervisor for effective integration	ETP

Before program	After program	Aids to learning
I need more courses or practice to increase my knowledge of using technology. “When I feel confident in my tech skills, I am more likely to integrate technology into my teaching”	The XO game, which I first learned about in the ETP	ETP
“At first, there was reluctance to use technology”	“After the fieldwork, things were excellent and I could explain these new technological ways. It [her self-efficacy] increases, not decreases. So, it is important to develop ourselves from time to time and be updated”	PPE
“Medium level, I am not an expert in using computers. It is easy; in some things, it is difficult to enter into; for example, in some lessons we took on the use of computers in education, without a background on the subject or its application and experience, the matter would be complicated”	“There is a big difference. After the end of the program, I feel ready to teach more so I am on my way to the best, such as doing electronic tests and the method of teaching English.” It’s [her own efficacy] completely different. It took more information and ideas with training and it developed. With the improvement process, it got even better.”	ETP; PPE

The impact on PSTs when observing and learning from peers included collaborating with experienced educators and mentors who used technology effectively in teaching and acted as role models. This was illustrated by Ahood, who highlighted the influence of her mentor and peers in enabling her to experiment with new (to Ahood) ICT tools to enhance student engagement and provide access to a wider range of resources (see Section 6.8.2).

Aisha began her technology integration journey with a superficial familiarity with PowerPoint. Through collaborative endeavours with peers during field training, her knowledge and skill in PowerPoint evolved significantly. This transformation empowered her to utilize the tool more effectively, marking a substantial growth in her technological proficiency. Similarly, Aqbal had the opportunity to experience hands-on training and observing experienced teachers enabled her to apply live models to enhance the understanding of her students (see Section 6.5.2). Lamia too outlined how her students benefited from the influences of her mentor teacher during PPE/TPK, as these enabled both to learn from each other’s mistakes when utilising an ICT game as an educational tool (see Section 6.4.2).

This type of modelling not only facilitates experimentation but contributes to a deeper understanding of TPACK and how to effectively integrate ICT into teaching. As pointed out by Barak et al. (2011), modelling served as a valuable tool in teaching and learning, providing learners with concrete examples to follow and learn from. In this context, the use of ICT tools not only aided in practical application but also nurtured a broader understanding of effective teaching methodologies. Organizing training according to the principles of TPACK and SAMR enabled pre-service teachers to experience the modelling of and then application of this knowledge in their real classroom and other similar contexts. West & Graham (2007) reported that when the context of the activities was similar to a PST's teaching context, it was easier for the PST to apply the knowledge.

PSTs had an initial opportunity to refine their teaching skills through Technology Integration Courses in the preparation program. For example, Ahood had an early opportunity to enhance her teaching skills through standalone Technology Integration Courses, equipping her with essential knowledge and skills to seamlessly integrate technology in her lessons (see Section 6.8.3). Despite possessing a solid foundation in technology use, Ahood sought enhanced technology integration into her educational practices. Engaging in peer review, she explored new tools such as Canva, which proved instrumental in using engaging lesson slides from ready-made templates. The satisfaction Ahood derived from the transformation in her technological proficiency was palpable, particularly through collaborative learning experiences. In the realm of computer specialization, Lamia faced initial challenges operating a smart screen device. Engaging in a course and collaborative efforts with colleagues became pivotal in her educational practices in utilizing projectors, smart screens and various other methodologies. Ultimately, Lamia's skills expanded and she expressed gratitude for the valuable support and learning experiences that contributed to her technological advancement. Afnanh's educational journey underwent a notable shift when she recognized her limitations in teaching math and was encouraged to undertake training in new approaches. Her realisation first prompted a transition to using presentations, particularly PowerPoint, to convey information. Then, through the education technology course, she not only mastered the Nearpod program, but also endeavoured to apply the (TPACK) theory in her lesson design. Afnanh's efforts were recognized

and praised by her supervisor, which validated the effectiveness of her efforts to incorporate new technology into her teaching methodology.

These findings complement those outlined in existing research in this field. For example, research in the United States showed that PSTs can benefit from engaging in authentic learning experiences that enable them to apply their knowledge of technology integration in real-world contexts (Harris & Hofer, 2009) and, further, that this learning is enhanced by collaborating in a course based on TPACK for technology integration (Karns, 2019). Similarly, in Singapore, PSTs were taught at least two subjects and benefitted from courses focusing on technology integration (Koh et al., 2010). TPACK courses are also beneficial for PSTs in Germany, courses that provided ongoing support and training (Tondeur et al., 2017). Studies in Singapore also found that a supportive learning environment encouraged PST experimentation and risk-taking with technology, as the environment included providing access to resources and support from mentors and peers (Koh & Chai, 2011). German studies also found that collaborating with mentors, peers and experienced teachers who shared ideas could provide invaluable guidance and support in using technology for pre-service teachers (Valtonen et al., 2017) and that professional development programs that specifically focussed on integrating technology in teaching could enhance PST technological pedagogical content knowledge (TPACK) (Zimmermann 2021). Such programs can also provide training, resources and support to develop PST skills and confidence in using technology effectively (Instefjord & Munthe, 2017; Benton-Borghi et al., 2015).

The findings of the current study shed light on the critical importance of exposing pre-service teachers to examples of best practices in technology integration. This exposure emerged as a key factor in inspiring and motivating pre-service teachers to enhance their utilization of technology. Various methods, such as classroom observations, case studies and the examination of successful technology integration projects, were identified as effective means to cultivate such inspiration. Furthermore, participants in this study explicitly acknowledged the significant benefits of learning from experienced educators (Chapter 6). They particularly highlighted the value of cooperating teachers who were skilled in presenting specific tools, as well as peers who had gained insights from an ETP course in which the TPACK and SAMR frameworks played central roles in shaping their lessons. The impact of these role

models, embodying the successful integration of technology into their teaching practices, was instrumental in influencing the attitudes and practices of pre-service teachers.

This pivotal finding underscores the crucial role of modelling and mentoring in facilitating the integration of technology into teaching practices. The study advocates for observation and collaboration with experienced teachers who excel at incorporating technology in their classrooms. Drawing insights from the experienced educators provided pre-service teachers with valuable lessons in best practices and effective strategies for utilizing technology (Foulger et al., 2017; Rodríguez-Becerra et al., 2020).

This study also highlighted the importance of providing supportive scaffolds, such as manuals, guidelines and templates, to aid PSTs in navigating the complexities of integrating technology into their lesson plans (Zimmermann & Melle, 2019; Janssen & Lazonder, 2016). Real-world application emerged as another crucial aspect in enhancing the efficacy of technology integration, with opportunities for pre-service teachers to apply their knowledge and skills in authentic classroom settings, under the guidance of experienced educators (see Chapter 6).

Collaboration was identified as a strong common theme, with findings in this study suggesting that engaging with mentors, peers, or experienced teachers for idea-sharing can provide crucial guidance and support in using technology effectively (Valtonen et al., 2017). The exchange of ideas and experiences fostered a collaborative environment that nurtures growth and innovation in technology integration practices. Role models emerge as influential in this process, exemplifying specific goals, behaviours and strategies that aspiring educators internalize and imitate (Ahn et al., 2020; Kundu, 2020). This study underscores the importance of exposing pre-service teachers to successful role models in technology integration to instil a sense of efficacy and competence, encouraging them to adopt innovative practices in their own teaching.

Finally, personal factors, such as holding positive or negative attitude, also impacted technology integration of pre-service teachers (Yang & Gaskill, 2011). Results from the qualitative phase of the research supported quantitative findings which suggested that the PSTs in the current research were significantly impacted by having positive

attitudes and beliefs towards educational technology in their classrooms. Lamia, for example, demonstrated a nearly expert level of self-belief toward technology integration (see Section 6.4.2), which impacted her application of technology at a transformative level in the SAMR model (see Section 6.4.3).

7.7 Chapter Summary

In conclusion, the key finding of this mixed-methods analysis of factors influencing PST technology integration practices is that exposing pre-service teachers to best practices in technology integration through a holistic approach of modelling, mentoring and collaboration has a significant and transformative impact on their self-efficacy. This exposure not only inspired and motivated, but also provided practical insights and skills necessary for effective technology integration. Experienced educators played roles in exemplifying specific goals, behaviours and strategies that aspiring educators internalized and emulated.

By including cooperating teachers skilled in specific tools and peers informed by TPACK and SAMR models, role models played a pivotal role in inspiring and motivating pre-service teachers to enhance their own utilization of technology. By combining such practical insights and with practical professional development experience and theoretical guidance PSTs gained from models such as TPACK and SAMR, programs can better equip PSTs with the inspiration, motivation and skills necessary for effective and advanced technology integration.

As technology continues to play an increasingly prominent role in education, this study's insights contribute to the development of more effective strategies for preparing future educators to navigate how they integrate technology in their classrooms within an evolving landscape. As educational technology is changing all the time, teacher preparation programmes in Saudi Arabia can ensure that teachers are properly prepared for these changes by adopting a more holistic approach.

8. Conclusions and Recommendations

This chapter consists of the following sections:

- Introduction
- Addressing the Research Questions
- Limitations of the Study
- Implications of the Study
- Recommendations
- Concluding Remarks

8.1 Introduction

This study investigated challenges and opportunities associated with integrating digital technologies in education. It revealed that short-term training programs significantly boosted ICT confidence of pre-service teachers, particularly those preparing to become educators, which represents a promising initial step in enhancing teachers' technological pedagogical knowledge.

However, for a sustained and transformative shift in teaching practices, it is crucial to go beyond initial confidence gains and implement long-term professional development initiatives within a supportive educational context. Such a comprehensive approach would enable teachers to progress through the stages of technology integration, from *substitution* through *augmentation*, to *modification* and even *redefinition*, in line with the goals of the SAMR model. This would, in turn, ultimately enrich and transform the teaching and learning experience. Digital technologies were seen to encourage active participation, collaboration and critical thinking, creating a more interactive and dynamic educational environment that ultimately benefits both students and educators.

The study found that the pre-service teachers involved received sufficient initial knowledge and skills to apply their learning in terms of TPACK and SAMR to the lessons taught during their professional experience placement. Despite the scarcity of ICT teaching tools in public schools in the southern region of Saudi Arabia (the region of the study), these pre-service teachers proactively sought solutions to

circumvent this scarcity. Nevertheless, it is essential not to rely solely on the flexibility of pre-service teachers to compensate for a lack of ICT resources in public schools. This study recommends that policy be developed to address the shortage of educational technology tools by the Department of Education and the Government in order to enhance the teaching and learning process.

Throughout the study, it became evident that pre-service teachers held a positive attitude towards the TPACK and SAMR approaches and welcomed the opportunity to enhance their knowledge and skills for integrating technology. Teachers recognized the value of purposeful technology integration in improving student learning experiences and were willing to implement TPACK and SAMR approaches in their teaching practices. They also advocated for ongoing professional development to implement technology effectively in their teaching.

TPACK and SAMR offered a valuable approach to examining the type of knowledge and skills evident in teacher practice as they blended subject matter understanding with technology and pedagogy to support their student learning and knowledge creation. TPACK and SAMR provided a robust model for teachers, pre-service teachers, teacher educators and researchers in order to explore the intricacies of technology integration in modern learning environments, guiding the exploration of when and how technology should be used, helping to transform teaching and learning environments. Pre-service teachers who employed TPACK and SAMR in their practice gained a deeper understanding of how to navigate the complexities of ICT integration, fostering robust and meaningful learning experiences for their students.

The understanding that teacher preparation programs need to change and adapt in response to technology demands is consistent with larger conversations. In the absence of clear standards regarding technology integration, pre-service teachers may not be in a position to access and use technology effectively, thus limiting opportunities to enhance student learning experiences.

8.2 Addressing the Research Questions

The research questions from this study (Section 1.7) were:

1 Do Saudi pre-service teachers perceive they have sufficient level of knowledge, experience and self-efficacy to be classroom-ready to teach with technology.

2 How do Saudi pre-service teachers adapt the use of technology in their classroom through participation in educational technology programme (ETP) and professional placement experience (PPE)?

3 Does Saudi pre-service teachers' self-efficacy changes through the participation in a ETP and PPE if yes? What drives this change? If not, what are the potential reasons for this?

The study focused on pre-service teachers' perceptions of their technological self-efficacy and answered research question 1 (RQ1). Results showed the pre-service teachers' confidence in integrating ICT into teaching practices and their readiness to apply computer technology in their classes. Measures were put in place to determine self-efficacy among the factors of classroom management, instructional strategies and technology integration. Participants generally fell within the gap between quite a bit and a lot on the scale. This means that many PSTs claimed to have satisfactory to rather high theoretical confidence in these domains.

In terms of self-efficacy, the Saudi pre-service teachers who participated in this study exhibited great confidence in the application of teaching strategies and the use of technology in their teaching. Nevertheless, self-efficacy in student engagement and classroom management with technology registered average ratings, showing that teachers have a certain degree of confidence in dealing with classroom management and students' engagement with technology.

The results revealed that pre-service teachers' confidence in their knowledge of specific teaching methods, technology integration, classroom management and students' meaningful participation. However, perseverance in the implementation of technology integration and concealment or exaggeration of proficiency levels are noticed among the participants. This may be linked to previous experience and training.

Pre-service teachers face the following issues in incorporating technology into the process: lack of availability to technology, inadequate training, insufficient skills and practical constraints such as "I did not have enough knowledge and skills in technology integration. I knew PowerPoint superficially" and "I need more courses or practice to increase my knowledge of using technology.". These obstacles undermined the efficient technology assimilation into learning techniques and suggest necessity of

providing mentorship, continuous professional development and access to technology resources.

The study highlights the importance of comprehensive pre-service teacher preparation programs that include preparing PSTs to effectively integrate technology into the curriculum and training them on how content and technical components can be linked with student-centred teaching approaches, to engage students learning and form a strong learning environment and purposeful professional development that prepares teachers to effectively integrate technology into the curriculum. It also spotlights a psychological aspect of technology integration by pointing out the crucial parts of a teacher's belief in their ability and the need for proper and targeted intervention for effective technology integration. Research Question 2 (RQ2) was intended to investigate how the PSTs coped with the use of technology after undertaking the ETP and PPE experiences. Among the pre-service teachers, some showed significant learning in terms of using technology in their classrooms (which got the transformational level) and, in addition, adopted creative strategic tools to their practice. The second group employed only moderate adaptations and were able to adopt the technology partially (which got the enhancement level), with further progression still required. Conversely, some pre-service teachers made few changes to their teaching in integrating technology, suggesting that some more support and training might be needed in that domain. The results suggest that the ETP and PPE were effective for some PSTs, while others struggled to effectively incorporate technology into their classrooms. Therefore, it is essential to provide interventions that meet the needs of each individual teacher and help them integrate technology into their classroom smoothly.

The qualitative analysis shows that some pre-service teachers reached the transformative level according to the SAMR framework. Thus, the integration of technology now become the instructional method for these students. These educators embodied, not just improvement, but transformation of traditional techniques by including multimedia functions and more functionalities to uplift learning and engagement.

The growth of self-efficacy in preservice teachers is attributable to the factors such as course content, practical training, peer collaboration and group activities. This result

agrees with the research done before it, highlighting that experiential learning is very important in improving pre-service teachers' technological literacy.

The introduction of technology within the pre-service teacher education programs should not be limited to theoretical comprehension but include practical application and practice. This method provides the opportunity for conceptual knowledge and practical implementation named in those works.

Comprehending how to use popular tools such as PowerPoint is only part of the story. Research has shown that integrating a broader range of digital technologies into instruction leads to more innovative and learner-centred practices, pre-service teachers' need more guidance and support to be able to achieve this.

Research Question 3 (RQ3) explored whether self-efficacy changed as a result of engaging in the ETP and PPE and examined the reasons. The study identified significant changes in PST self-efficacy after course participation, which had a positive effect on self-efficacy.

The main message that comes out from the statistic (see Table 5-17 in Section 5.5.2), significant changes in self-efficacy were observed for Factors 1 and 2, but not for Factor 3. These results imply significant changes in participants' perceived competence in managing the classroom and engaging students following the intervention, highlighting the effectiveness of the programme in enhancing these aspects of teaching practice. Consequently, it becomes clear that the programme had resulted in the substantial improvement of a few critical areas of teaching methodologies, particularly in classroom management and student engagement.

The ETP and PPE, by means of deliberately introducing instructional approaches and practical training activities, contributed to this increase. The change observed in some pre-service teachers' attitudes and perceptions about their digital skills aligns with the ultimate purpose of promoting technological preparedness among future school educators through the ETP course. While many participants demonstrated growth, it's important to recognize that not all pre-service teachers experienced significant increases in their digital skills. Nonetheless, these findings suggest that the ETP programme has the potential to positively impact pre-service teachers' attitudes and perceptions regarding technology integration. Furthermore, it led to an increase in PSTs' technological self-efficacy due to availability of quality resources, such as

those provided valuable both frameworks, the SAMR model and the TPACK framework. These frameworks, the SAMR model and the TPACK framework, played a valuable role in the PST preparation for other classrooms where technology is now considered an integrated part of good teaching practices.

8.3 Limitations of the Study

Several limitations need to be acknowledged in this study, particularly:

- COVID-19.
- Lack of a control group.
- Size and generalizability.

Firstly, the number of pre-service teachers who participated in the post questionnaire was limited, which may, in part be due to COVID-19. The impact of the pandemic on self-efficacy scores remains unclear without a control group, emphasising the importance of incorporating control groups into future research so that interventions can be disentangled from external factors.

The Saudi Pre-Service Teachers' Sense of Efficacy Scale (TSES) scores from the beginning and the end of the term cannot be attributed solely to the intervention (ETP and PPE) or other external factors as there was no control group. This constraint is particularly relevant as it pertains to COVID-19, given that a pandemic might have introduced unexpected factors impacting the observed differences.

Limitations extend to the study's sample size and generalizability, lacking a control group and relying on a small sample size comprised entirely of one gender (female). The absence of a control group made it difficult to extend the findings and control for potential extraneous variables that might have influenced the results. The restricted availability of pre-service teachers willing to participate during PPE, exacerbated by intermittent lockdowns, contributed to the limited sample size. Nevertheless, despite the modest sample size, the study revealed significant differences in Saudi pre-service teachers' technology engagement (Fruth & Huber, 2015).

Furthermore, the conclusions drawn from this study are applicable exclusively to pre-service teachers across various disciplines at Saudi Universities in the Kingdom of Saudi Arabia (KSA). Since all pre-service teachers in KSA are under the Ministry of

Education, the findings do not offer insights into specific subject areas beyond the scope of the study. Geographically, the research is confined to KSA, limiting insights into educational practices in other countries. As a result, the researcher lacked data concerning specific subjects or locations outside of pre-service teachers enrolled in teacher preparation programs at Saudi universities.

Given these limitations, it is imperative to conduct additional studies to enhance understanding of the reliability and utility of the measures used to assess the self-efficacy beliefs of pre-service teachers. To enhance the generalizability of the findings, future research should replicate the study with pre-service teachers from diverse programs and geographic regions. This approach would address the limitations related to sample size, gender representation and geographical scope.

Limitations extend to the study's sample size and generalizability. The study relied on a small, gender-specific sample (female), and the absence of a control group further restricts the ability to generalize the findings. While the study provides in-depth insights into Saudi pre-service teachers' technology engagement, these findings should be interpreted with caution when considering broader applications to all Saudi PSTs or educational contexts outside of KSA. The restricted sample size, exacerbated by intermittent lockdowns during the COVID-19 pandemic, also limits the generalizability of the results. Therefore, future research should replicate the study with diverse programs and geographic regions to enhance the generalisability of the findings.

8.4 Implications of the Study

The study looked at the experiences of Saudi pre-service teachers in the context of educational technology in which TPACK and SAMR were used to aid integration of ICT into teaching. Self-efficacy was measured with a TSES.

Findings are of high importance in relation to the educational system in Saudi Arabia, as well as the practice of education world-wide.

Informing Policy Decisions

This study provides a basis for informed policy decisions by education planners and leaders in Saudi Arabia. The author advises that more funding need to be placed on

training which focusses on improving pre-service teacher TPACK- and SAMR-competence in line with the changing requirements of the virtual education environment.

Teacher Preparation Programs Enhancement

TPACK and SAMR should be integrated into pre-service teacher preparation programs in Saudi Arabia. Adoption of a blended teaching internship will equip the PSTs with practical skills and enable them to incorporate technology, pedagogy and content knowledge in teaching.

The study underscores the potential effectiveness of interventions in enhancing pre-service teacher self-efficacy, with observed improvements in self-efficacy scores before and after intervention. However, the implications are nuanced due to the absence of a control group, emphasizing the need for caution in attributing changes solely to the intervention. The study highlighted the relevance of addressing self-efficacy in teacher training programs, particularly in the context of challenges posed by external factors such as the COVID-19 pandemic.

Self-Efficacy and Confidence Building

The research emphasized self-efficacy scales to measure and improve pre-service teacher confidence with educational technology. Teachers could be assessed using similar measures that could be incorporated in any teaching programme to determine areas that require further intervention, such as supplementary materials for learning.

Although this study was about educators in Saudi it potentially has broader application. A system of universal education could be built by melding integral strategies consisting of TPACK, SAMR and teacher self-efficacy. Research reveals an indispensable role technology plays in education, the results of the study should thus serve as the basis for designing efficient techniques for pre-service teachers and teachers' professional development.

Need for All-Round Approach

Finally, this research's implications indicate that there is a need for an all-round approach towards the incorporation of educational technology, involving practical training, budgetary allocations and self-efficacy appraisal. Through these recommendations, Saudi Arabia and other educational systems need to educate their

PSTs so that they will be able to respond positively and agilely to the ever-emerging demands in 21st century learning spaces.

8.5 Recommendations

This research makes an original addition to the corpus of knowledge about the integration of educational technologies in advanced classrooms and the foundation that this section provides will be of great value to the future studies in this field.

The following recommendations outline potential avenues for addressing remaining gaps and advancing knowledge in this area:

Explore Gender Dynamics: Together with examining how to embed educational technologies and educate pre-service teachers who have positive perception and skills in technology usage, further research should explore the inclusion of males in a study of this kind. This research could provide useful information for policy makers who strive to make use of educational technology for both genders.

- Future research should instead provide a direction towards creating technology integration throughout teaching courses, applying them to the pre-service teacher education and assessing their classroom interaction. Through a comprehensive approach and strategy of curriculum design and pedagogy, specifically designed courses empower pre-service teachers to be equipped to tackle global educational issues.
- It may also be helpful for researchers and stakeholders to investigate if and how diverse social perspectives impact pre-service teachers' supervisors in different universities. With the aid of the theoretical lens employed in this study, it can contribute to identifying needs of pre-service teachers of different backgrounds.
- Further research should also involve looking at the variations in the scores on the Teachers' Sense of Efficacy Scale (TSES) among the pre-service teachers for gaining insights into the factors influencing their confidence and competence in using technology for teaching purposes. Interpreting results of TSES will give an indication of the efficiency of technological tool implementation in developing teachers' confidence and skills to be used in classroom activities.

- Teacher preparation programs must meet the needs and requirements of integrating technology into teaching because failure to do so may result in pre-service teachers lacking the necessary skills and knowledge to use technology effectively in the classroom.
- Also, government policy without clear standards regarding the effective integration of technology, pre-service teachers may have difficulty integrating technology into their teaching practice, which may also limit the enhancement of student learning experiences through this technological advancement.

8.6 Concluding Remarks

This mixed methods study meticulously investigated the adoption of ICT technologies among pre-service teachers in Saudi Arabia and in particular its association with their ICT self-efficacy. This research undertook a holistic analysis of the multi-aspect components that effect technology integration efficiency of pre-service educators in Saudi Arabia. This study contributes to a deeper understanding of the critical factors and challenges that effect the instructors' confidence and capabilities through meticulous analysis. The thesis presents valuable insight into what makes using technology in teaching demanding. This research project hereby establishes a fundamental step in the appropriate and efficient utilization of educational technology in the education of pre-service teachers in Saudi Arabia. It harmonizes key theories, reflecting the balance between scientific knowledge and practical implementation which is essential for achieving the objectives of the Saudi 2030 Vision. In this way, this effort involves not only adaptation of emerging technologies but also fit with the country's objective of international competitiveness. Consequently, this means a key step towards bridging the gap between the education processes and ongoing tech development, thus leading to the achievement of the Vision 2030 goals.

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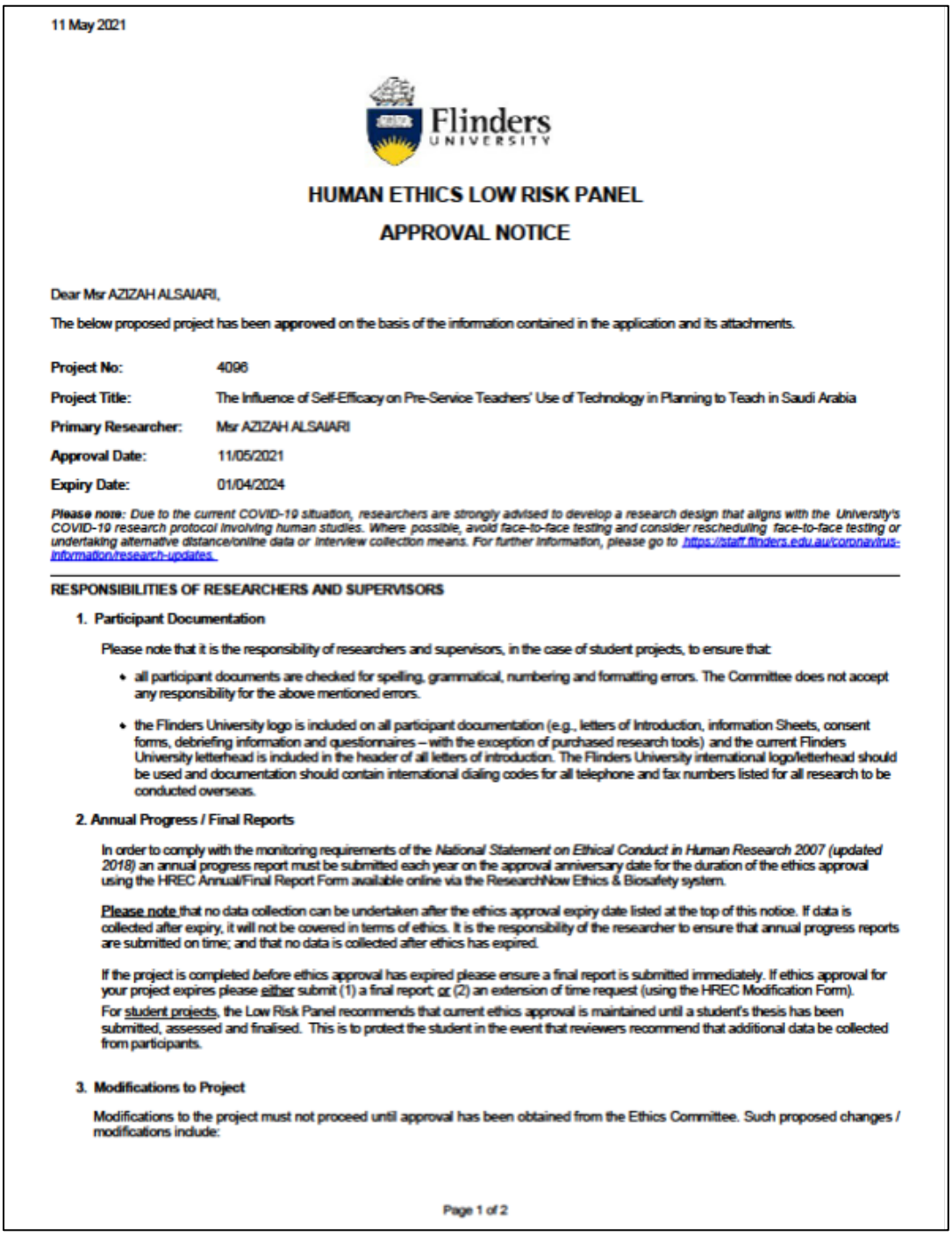
Appendices

Appendix A. Ethics and TSET Approvals

Figure A-1 shows the ethics approval form for this study.



11 May 2021

Flinders UNIVERSITY

HUMAN ETHICS LOW RISK PANEL

APPROVAL NOTICE

Dear Msr AZIZAH ALSAIARI,

The below proposed project has been approved on the basis of the information contained in the application and its attachments.

Project No:	4096
Project Title:	The Influence of Self-Efficacy on Pre-Service Teachers' Use of Technology in Planning to Teach in Saudi Arabia
Primary Researcher:	Msr AZIZAH ALSAIARI
Approval Date:	11/05/2021
Expiry Date:	01/04/2024

Please note: *Due to the current COVID-19 situation, researchers are strongly advised to develop a research design that aligns with the University's COVID-19 research protocol involving human studies. Where possible, avoid face-to-face testing and consider rescheduling face-to-face testing or undertaking alternative distance/online data or interview collection means. For further information, please go to https://staff.flinders.edu.au/coronavirus-information/research-updates*

RESPONSIBILITIES OF RESEARCHERS AND SUPERVISORS

1. **Participant Documentation**

   Please note that it is the responsibility of researchers and supervisors, in the case of student projects, to ensure that:

   - all participant documents are checked for spelling, grammatical, numbering and formatting errors. The Committee does not accept any responsibility for the above mentioned errors.
   - the Flinders University logo is included on all participant documentation (e.g., letters of Introduction, information Sheets, consent forms, debriefing information and questionnaires – with the exception of purchased research tools) and the current Flinders University letterhead is included in the header of all letters of introduction. The Flinders University international logo/letterhead should be used and documentation should contain international dialing codes for all telephone and fax numbers listed for all research to be conducted overseas.

2. **Annual Progress / Final Reports**

   In order to comply with the monitoring requirements of the *National Statement on Ethical Conduct in Human Research 2007 (updated 2018)* an annual progress report must be submitted each year on the approval anniversary date for the duration of the ethics approval using the HREC Annual/Final Report Form available online via the ResearchNow Ethics & Biosafety system.

   Please note that no data collection can be undertaken after the ethics approval expiry date listed at the top of this notice. If data is collected after expiry, it will not be covered in terms of ethics. It is the responsibility of the researcher to ensure that annual progress reports are submitted on time; and that no data is collected after ethics has expired.

   If the project is completed *before* ethics approval has expired please ensure a final report is submitted immediately. If ethics approval for your project expires please either submit (1) a final report; or (2) an extension of time request (using the HREC Modification Form).

   For student projects, the Low Risk Panel recommends that current ethics approval is maintained until a student's thesis has been submitted, assessed and finalised. This is to protect the student in the event that reviewers recommend that additional data be collected from participants.

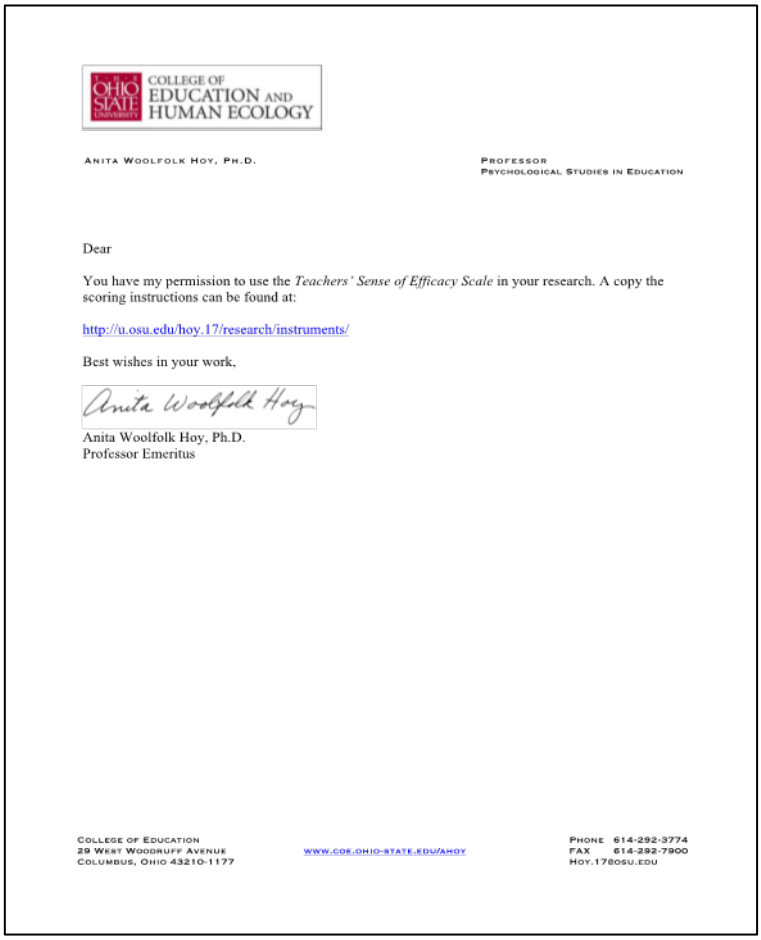
3. **Modifications to Project**

   Modifications to the project must not proceed until approval has been obtained from the Ethics Committee. Such proposed changes / modifications include:

Page 1 of 2

Figure A-1. Ethics approval form

Figure A-2 shows the approval letter for use of the Teacher Self-efficacy Test (TSET).



COLLEGE OF EDUCATION AND HUMAN ECOLOGY

ANITA WOOLFOLK HOY, PH.D.

PROFESSOR
PSYCHOLOGICAL STUDIES IN EDUCATION

Dear

You have my permission to use the *Teachers' Sense of Efficacy Scale* in your research. A copy the scoring instructions can be found at:

http://u.osu.edu/hoy.17/research/instruments/

Best wishes in your work,

Anita Woolfolk Hoy

Anita Woolfolk Hoy, Ph.D.
Professor Emeritus

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Figure A-2. Approval for use of TSET

This document can be found at the following location: https://bpb-us-w2.wpmucdn.com/u.osu.edu/dist/2/5604/files/2014/09/permission-letter-18p6bcg.pdf

Appendix B. Teachers' Self-efficacy Test Questions

The following questions made up the modified Teacher Self-efficacy Test (TSET):

1. How much can you do to control behaviour in the classroom?
2. How much can you do to motivate students who show low interest?
3. How much can you do to get students to believe they can do well in studying?
4. How confident are you to integrate technology with instruction?
5. How much can you do to help your students value learning?
6. To what extent can you craft good questions for your students?
7. How well can you adopt and adapt technology to specific learning tasks?
8. How much can you do to get students to follow classroom rules?
9. How much can you do to calm a student who is disruptive?
10. How well can you establish a classroom management system with each group of students?
11. How confident are you to create new ways to use technology in your teaching?
12. How much can you use a variety of assessment strategies?
13. To what extent can you provide an alternative explanation or example when students are confused?
14. How useful do you think technology is for enhancing your teaching?
15. How much can you do to get students to work together?
16. How well can you implement alternative strategies in your classroom?

Questions were assigned to categories as described in Table B-1.

Table B-1. Initial familiarity with technology

Category	Questions
Efficacy in Student Engagement	2, 3, 5, 15
Efficacy in Instructional Strategies	6, 12, 13, 16
Efficacy in Classroom Management	1, 8, 9, 10
Efficacy in Technologies Integration	4, 7, 11, 14

Appendix C. Observation Checklist for SAMR

I use the checklist to observe preservice teachers in the classroom, noting the level of technology integration according to the SAMR model. The following is an observation checklist that could be used for SAMR (adapted from Puentedura, 2020).

Each level of SAMR (see Section 3. 4. 5) has the following:

- Definition
- Examples
- Functional change
- Score

Level – Substitution

Definition

Computer technology is used to perform the same task as was done before the use of computers.

Examples

Students print out worksheet, finish it, pass it in.

Functional Change

No functional change in teaching and learning. There may be times when this is the appropriate level of work as there is no real gain to be had from computer technology. One needs to decide computer use based on any other possible benefits. This area tends to be teacher-centric where the instructor is guiding all aspects of a lesson.

Score – 1

Level – Augmentation

Definition

Computer Technology offers an effective tool to perform common tasks.

Examples

Students take a quiz using a Google Form instead of using pencil and paper.

Functional Change

There is some functional benefit here in that paper is being saved, students and teacher can receive almost immediate feedback on student level of understanding of material. This level starts to move along the teacher / student centric continuum. The impact of immediate feedback is that students may begin to become more engaged in learning.

Score – 2

Level – Modification

Definition

This is the first step over the line between enhancing the traditional goings-on of the classroom and transforming the classroom. Common classroom tasks are being accomplished through the use of computer technology.

Examples

Students are asked to write an essay around the theme “And This I Believe...”. An audio recording of the essay is made along with an original musical soundtrack. The recording will be played in front of an authentic audience such as parents, or college admission counsellors.

Functional Change

There is significant functional change in the classroom. While all students are learning similar writing skills, the reality of an authentic audience gives each student has a personal stake in the quality of the work. Computer technology is necessary for this classroom to function allowing peer and teacher feedback, easy rewriting and audio recording. Questions about writing skills increasingly come from the students themselves.

Score – 3

Level – Redefinition

Definition

Computer technology allows for new tasks that were previously inconceivable.

Examples

Students being taught are asked to create a documentary video answering an essential question related to important concepts. Teams of students take on different subtopics and collaborate to create one final product. Teams are expected to contact outside sources for information.

Functional Change

At this level, common classroom tasks and computer technology exist not as ends but as supports for student-centred learning. School students learn content and skills in support of important concepts as they pursue the challenge of creating a professional quality video. Collaboration becomes necessary and technology allows such communications to occur. Questions and discussion are increasingly student generated.

Score – 4

Appendix D Interview Questions in English and Arabic

This appendix lists the English and Arabic versions of interview questions.

Definition

English

Self-efficacy

Arabic

إدراك الفرد لقدراته على أداء سلوك معين بنجاحاعتقادك وادراكك وثقتك بقدراتك)

ومهاراتك في استخدام التكنولوجيا في التعليم(ليست قدرتك الفعلية ولكن نظرتك لقدرت ك

افكار الفرد واعتقاده حول قدراته في

استخدام التكنولوجيا في التعل م

Question 1

English

How do you feel about your ability in using tech for learning?

Arabic

ما هو شعورك حيال قدرتك على استخدام التكنولوجيا للتعلم؟

Question 2

English

Do you have enough knowledge about How would you connect pedagogy with ICT? If yes how?

Arabic

هل لديك معرفة كافية حول كيف يمكنك ربط علم أصول التدريس بتكنولوجيا المعلومات والاتصالات؟ اذا نعم كيف؟

Question 3

English

How do you rate yourself in using ICT (beginner or expert)? How?

Arabic

كيف تقيم نفسك في استخدام تكنولوجيا المعلومات والاتصالات)مبتدئ أم خبير(؟

Question 4

English

Do you think you are confident in using computers? How?

Arabic

هل تعتقد أنك واثق في استخدام الكمبيوتر؟ كيف؟

Question 5

English

Do you think your self-efficacy about using technology in learning to influence your decision in using technology to enhance student learning? How?

Arabic

هل تعتقد أن كفاءتك الذاتية حول استخدام التكنولوجيا في التعلم للتأثير على قرارك في استخدام التكنولوجيا لتعزيز تعلم الطلاب؟ كيف ؟

Appendix E. Detail of Psychometric Investigation

Table E-1 details the psychometric investigation conducted on a nine-point scale, higher scores indicating greater impact (Section 5.2.4).

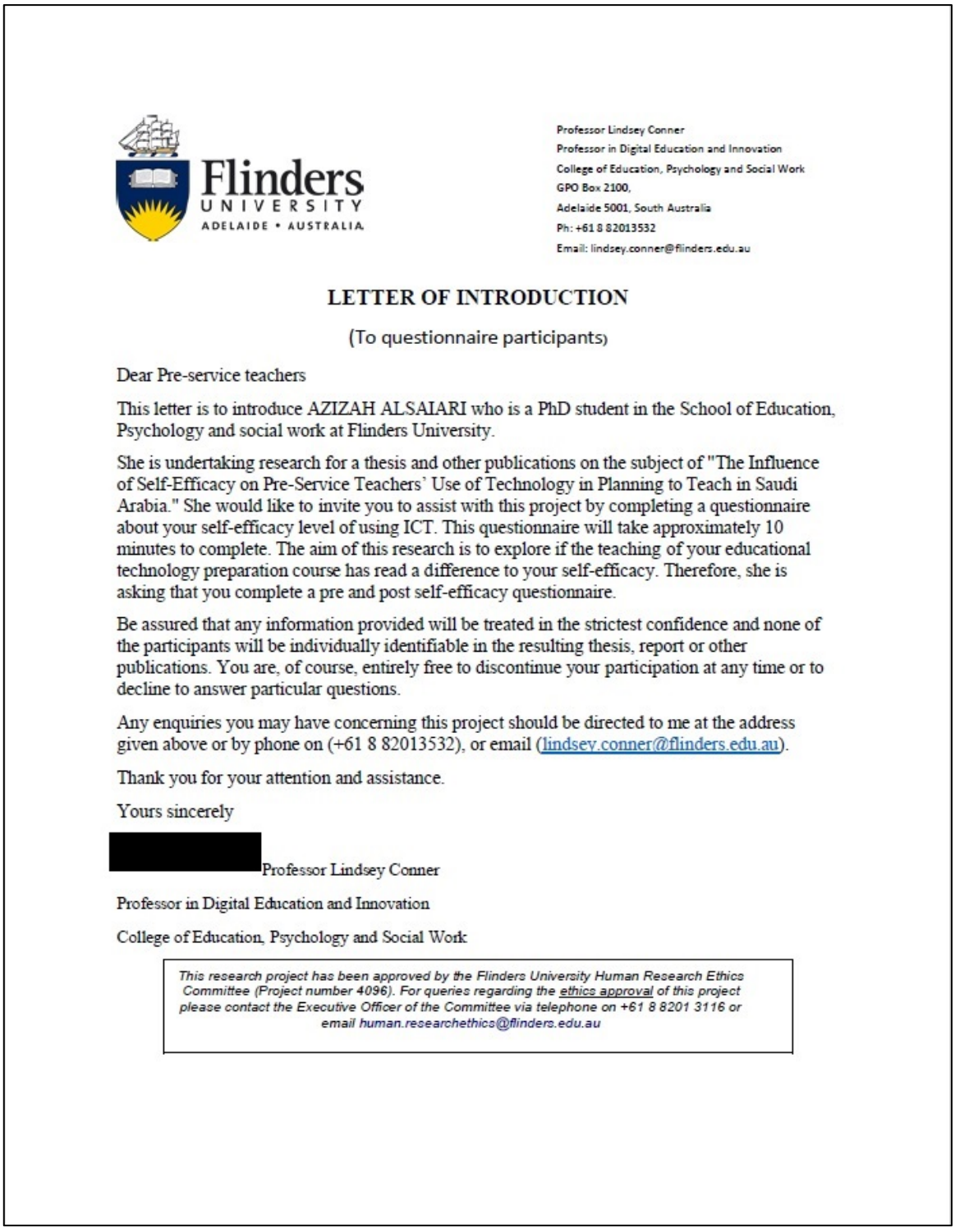
Table E-1. Detail of psychometric investigation

		A		B		C		D		E		F		G		H		I		Total	
	Mean	Row n(%)	n	Row (%)	n	Row (%)	n	Row (%)	n	Row (%)	n	Row (%)	n	Row (%)	n	Row (%)	n	Row (%)	n	Row (%)
V1	5.78	0.0	1	1.1	6	6.5	9	9.8	33	35.9	7	7.6	27	29.3	1	1.1	8	8.7	92	100.0
V2	6.26	1.1	0	0.0	6	6.5	9	9.8	27	29.3	8	8.7	13	14.1	5	5.4	23	25.0	92	100.0
V3	6.62	1.1	0	0.0	2	2.2	8	8.7	22	23.9	9	9.8	19	20.7	6	6.5	25	27.2	92	100.0
V4	6.83	0.0	1	1.1	10	10.9	4	4.3	9	9.8	4	4.3	27	29.3	11	12.0	26	28.3	92	100.0
V5	6.72	0.0	0	0.0	4	4.3	8	8.7	16	17.4	10	10.9	22	23.9	8	8.7	24	26.1	92	100.0
V6	6.80	0.0	1	1.1	4	4.3	3	3.3	18	19.6	7	7.6	25	27.2	13	14.1	21	22.8	92	100.0
V7	5.78	0.0	3	3.3	10	10.9	7	7.6	32	34.8	6	6.5	14	15.2	6	6.5	14	15.2	92	100.0
V8	5.99	1.1	3	3.3	3	3.3	12	13.0	22	23.9	11	12.0	20	21.7	9	9.8	11	12.0	92	100.0
V9	6.10	3.3	4	4.3	3	3.3	4	4.3	29	31.5	6	6.5	19	20.7	5	5.4	19	20.7	92	100.0
V10	5.39	3.3	3	3.3	13	14.1	10	10.9	24	26.1	8	8.7	17	18.5	5	5.4	9	9.8	92	100.0
V11	5.67	6.5	0	0.0	12	13.0	9	9.8	16	17.4	14	15.2	14	15.2	7	7.6	14	15.2	92	100.0
V12	5.86	2.2	1	1.1	9	9.8	9	9.8	21	22.8	16	17.4	14	15.2	7	7.6	13	14.1	92	100.0
V13	6.12	1.1	4	4.3	6	6.5	7	7.6	19	20.7	15	16.3	13	14.1	11	12.0	16	17.4	92	100.0
V14	6.92	1.1	1	1.1	2	2.2	6	6.5	19	20.7	6	6.5	15	16.3	10	10.9	32	34.8	92	100.0
V15	6.87	1.1	1	1.1	1	1.1	3	3.3	20	21.7	12	13.0	14	15.2	16	17.4	24	26.1	92	100.0
V16	5.68	3.3	3	3.3	5	5.4	13	14.1	26	28.3	10	10.9	13	14.1	5	5.4	14	15.2	92	100.0

Appendix F. Information Sheet and Consent Forms

This appendix contains the letter of introduction and consent forms.

The letter of introduction is contained in Figure F-1 (signature redacted).



Flinders UNIVERSITY
ADELAIDE • AUSTRALIA

Professor Lindsey Conner
Professor in Digital Education and Innovation
College of Education, Psychology and Social Work
GPO Box 2100,
Adelaide 5001, South Australia
Ph: +61 8 82013532
Email: lindsey.conner@flinders.edu.au

LETTER OF INTRODUCTION

(To questionnaire participants)

Dear Pre-service teachers

This letter is to introduce AZIZAH ALSAIARI who is a PhD student in the School of Education, Psychology and social work at Flinders University.

She is undertaking research for a thesis and other publications on the subject of "The Influence of Self-Efficacy on Pre-Service Teachers' Use of Technology in Planning to Teach in Saudi Arabia." She would like to invite you to assist with this project by completing a questionnaire about your self-efficacy level of using ICT. This questionnaire will take approximately 10 minutes to complete. The aim of this research is to explore if the teaching of your educational technology preparation course has read a difference to your self-efficacy. Therefore, she is asking that you complete a pre and post self-efficacy questionnaire.

Be assured that any information provided will be treated in the strictest confidence and none of the participants will be individually identifiable in the resulting thesis, report or other publications. You are, of course, entirely free to discontinue your participation at any time or to decline to answer particular questions.

Any enquiries you may have concerning this project should be directed to me at the address given above or by phone on (+61 8 82013532), or email (lindsey.conner@flinders.edu.au).

Thank you for your attention and assistance.

Yours sincerely

[redacted] Professor Lindsey Conner

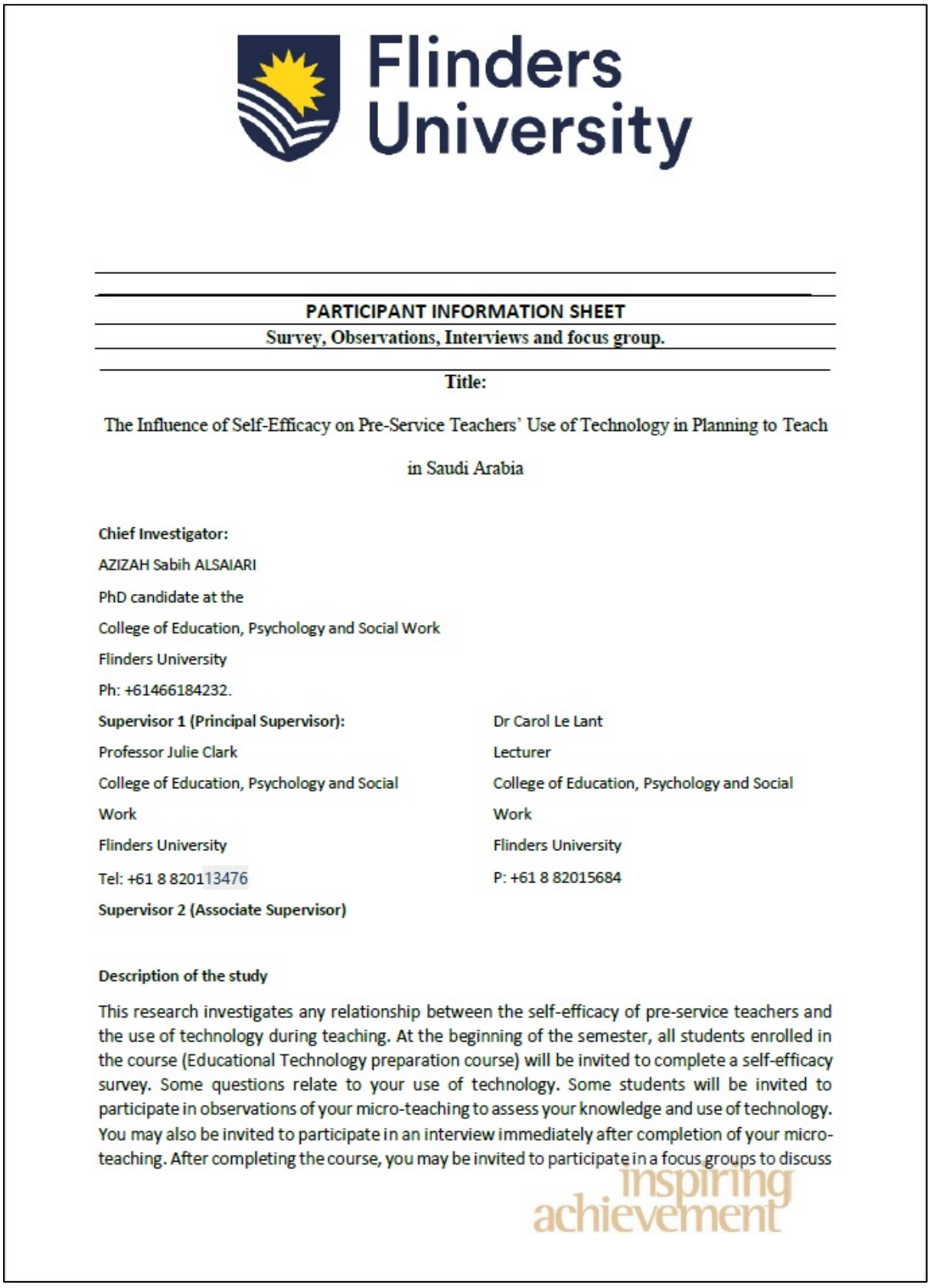
Professor in Digital Education and Innovation

College of Education, Psychology and Social Work

This research project has been approved by the Flinders University Human Research Ethics Committee (Project number 4096). For queries regarding the ethics approval of this project please contact the Executive Officer of the Committee via telephone on +61 8 8201 3116 or email human.researchethics@flinders.edu.au

Figure F-1. Letter of introduction (redacted)

Pages 1 through 8 of the consent form are contained in Figures F-2 through F-9.



Flinders University

PARTICIPANT INFORMATION SHEET

Survey, Observations, Interviews and focus group.

Title:

The Influence of Self-Efficacy on Pre-Service Teachers' Use of Technology in Planning to Teach in Saudi Arabia

Chief Investigator:

AZIZAH Sabih ALSAIARI

PhD candidate at the

College of Education, Psychology and Social Work

Flinders University

Ph: +61466184232.

Supervisor 1 (Principal Supervisor):

Professor Julie Clark

College of Education, Psychology and Social Work

Flinders University

Tel: +61 8 820113476

Dr Carol Le Lant

Lecturer

College of Education, Psychology and Social Work

Flinders University

P: +61 8 82015684

Supervisor 2 (Associate Supervisor)

Description of the study

This research investigates any relationship between the self-efficacy of pre-service teachers and the use of technology during teaching. At the beginning of the semester, all students enrolled in the course (Educational Technology preparation course) will be invited to complete a self-efficacy survey. Some questions relate to your use of technology. Some students will be invited to participate in observations of your micro-teaching to assess your knowledge and use of technology. You may also be invited to participate in an interview immediately after completion of your micro-teaching. After completing the course, you may be invited to participate in a focus groups to discuss

Figure F-2. Page 1 of consent form

any aspects about how the course supported you to learn about technologies and if you gained confidence by doing the course. As aprt of your course, you will be asked to write a reflection statement and again you may be invited to share this with the researcher. At the end of the course, you will also be invited to participate in the self-efficacy survey again. The results will be compared before and after the course to identify and compare any changes in the test results. This study is supported by Flinders University, School of Education, Psychology and Social Work.

Purpose of the study:
This project aims to:

1- Assess and measure the Saudi PSTs self-efficacy of using technology in their teaching.
2- Explore how PSTs use ICT in various ways and how they adapt ICT in their teaching before and after they participate in the course.
3- Examine the links between PSTs self-efficacy and the use of technology, especially in the Saudi context.

.

What will I be asked to do?

- You will be invited to participate in a pre- and post- survey to collect data on pre-service teacher's self-efficacy.
- You are further invited to consent in order to be observed during a micro-teaching lesson and an interview immediately after completing the lesson. The interview will take between 45-60 minutes. The audio of the observation, interview and focus group will be recorded via the Zoom app as all participants will be asked to turn their cameras off. The interview will be transcribed and stored as a computer file on the Flinders University cloud with password protection.
- **(Interviewees will receive $40 as compensation for their time).**

What benefit will I gain from being involved in this study?
The sharing of your experiences will help in developing professional development to prepare PSTs in Saudi Arabia universities, as well as contribute to understanding how ICT development of PSTs occurs in the Saudi context and potentially more generally for the rest of the world.

Will I be identifiable by being involved in this study?
While responses will not be anonymous, to enable data matching across data sets, they will remain confidential. Once data is matched, it will be de-identified to maintain confidentiality. Your name and other personal details will always be kept confidential. No part of this research project will allow identification of any participant. All data will be stored on the University cloud and be password protected. Project information will only be available for use by the researcher.

Are there any risks or discomforts if I am involved?
We do not anticipate any discomfort or risk arising from your participation in this study. However, if you become distressed during your involvement in the interview you will be referred to the free counselling service offered to all universitys' staff and students. If you have any concerns regarding anticipated or actual risks or discomfort, please raise them with the researcher initially and she will recommend you contact the free counselling service or you can also contact the following services for support:

- Saudi Health Ministry's 937 Call

How do I agree to participate?
Participation is voluntary. You may answer 'no comment' or refuse to answer any questions and you are free to withdraw from participating in the study (in survey/ observation/ interview/ focus group) at any time without negative consequences. A consent form accompanies this information sheet. If you agree to

Figure F-3. Page 2 of consent form

participate, please read and sign the form and give it back to the researcher or through the Qualtrics survey. The researcher may contact you, either by e-mail or a phone call to arrange an appointment for your micro teaching at a time that is convenient for both parties.

Confidentiality and Privacy
Only researchers listed on this form have access to the individual information provided by you. Privacy and confidentiality will be assured at all times. The research outcomes may be presented at conferences, written up for publication or used for other research purposes as described in this information form. However, all individual information will be de-identifiable in any research products.

The data will be transcribed by an external company to verify translation, in an unidentified form, of participants information.

No data, including identifiable, non-identifiable and de-identified datasets, will be shared or used in future research projects without your explicit consent.

Data Storage
The information collected may be stored securely on a password protected Flinders University server throughout the study. Any identifiable data will be de-identified for data storage purposes unless indicated otherwise. All data will be securely transferred to and stored at Flinders University for at least five years after publication of the results. Following the required data storage period, all data will be securely destroyed according to university protocols.

How will I receive feedback?
The feedback of the interview transcription will be provided to each participant by email to edit and review. Outcomes from the project will be summarised and given to you by the researcher if you would like to see them.

Possible Conflict of Interest Declared

There is a possibility of perceived conflict of interest due to relationships which may have been established through previous work interactions. This may create an obligation on the part of the participants to feel obliged to participate or to answer in ways that compromise the research. This will be managed through (a) in this letter and (c) in the thesis.

Ethics Committee Approval
The project has been approved by Flinders University's Human Research Ethics Committee *(4096)*.

Queries and Concerns
Queries or concerns regarding the research can be directed to the research team. If you have any complaints or reservations about the ethical conduct of this study, you may contact the Flinders University's Research Ethics & Compliance Office team via telephone +61 8 8201 3116 or email human.researchethics@flinders.edu.au.

Thank you for taking the time to read this information sheet which is yours to keep. If you accept our invitation to be involved, please sign the enclosed Consent Form through the Qualtrics https://qualtrics.flinders.edu.au/jfe/form/SV_9TcacbSTihWPz2m

Figure F-4. Page 3 of consent form

CONSENT FORM

Consent Statement

- ❑ I have read and understood the information about the research, and I understand I am being asked to provide informed consent to participate in this research study. I understand that I can contact the research team if I have further questions about this research study.
- ❑ I am not aware of any condition that would prevent my participation, and I agree to participate in this project.
- ❑ I understand that I am free to withdraw at any time during the study.
- ❑ I understand that I can contact Flinders University's Research Ethics & Compliance Office if I have any complaints or reservations about the ethical conduct of this study.
- ❑ I understand that my involvement is confidential, and that the information collected may be published. I understand that I will not be identified in any research products.

I further consent to:

- ❑ completing a questionnaire
- ❑ My observation while I'm doing the lesson
- ❑ participating in a Focus Group discussion
- ❑ having my information audio recorded

Review / Approval of Survey, Observation & interview Transcriptions

I, the participant whose signature appears below, have read a transcript of my Observation & interview participation and agree to its use by the researcher as explained.

Participant's signature……Date……..

This research project has been approved by the Flinders University Human Research Ethics Committee. (Project number 4096). For queries regarding the ethics approval of this project please contact the Executive Officer of the Committee via telephone on +61 8 8201 3116 or email human.researchethics@flinders.edu.au

Signed:

Name:

Date:

Figure F-5. Page 4 of consent form

ورقة معلومات المشارك

المسح والملاحظات والمقابلات ومجموعة التركيز.

:عنوان

تأثير الاكتفاء الذاتي على استخدام معلمي ما قبل الخدمة للتكنولوجيا في التخطيط للتدريس في المملكة العربية السعودية

:الباحث الرئيس

عزيزة صبيح الصيعري

مرشح دكتوراه في

كلية التربية وعلم النفس والخدمة الاجتماعية

جامعة فليندرز

هاتف: +61466184232. (تم التعديل)استعادة الترجمة الأصلية

:(مشرف 1 (مشرف رئيسي

البروفيسور ليندسي كونر

أستاذ في التعليم الرقمي والابتكار

كلية التربية وعلم النفس والخدمة الاجتماعية

جامعة فليندرز

هاتف: +61 8 82013532

(مشرف 2 (مشرف مشارك

الدكتورة كارول لو لانت

محاضر

كلية التربية وعلم النفس والخدمة الاجتماعية

جامعة فليندرز

هاتف: +61 8 82015684

Figure F-6. Page 5 of consent form

وصف الدراسة

يبحث هذا البحث في أي علاقة بين الكفاءة الذاتية لمعلمي ما قبل الخدمة واستخدام التكنولوجيا أثناء التدريس. في بداية الفصل الدراسي، سيتم دعوة جميع الطلاب المسجلين في الدورة (دورة إعداد تكنولوجيا التعليم) لاستكمال استبيان الكفاءة الذاتية. تتعلق بعض الأسئلة باستخدامك للتكنولوجيا. ستتم دعوة بعض الطلاب للمشاركة في ملاحظات التدريس المصغر الخاص بك لتقييم معرفتك واستخدامك للتكنولوجيا. قد تتم دعوتك أيضًا للمشاركة في مقابلة مباشرة بعد الانتهاء من التدريس المصغر الخاص بك. بعد الانتهاء من الدورة، قد تتم دعوتك للمشاركة في مجموعات تركيز لمناقشة أي جوانب حول كيفية دعمك للدورة للتعرف على من الدورة التدريبية الخاصة بك، سيُطلب aprt التقنيات وما إذا كنت قد اكتسبت الثقة من خلال إجراء الدورة التدريبية. بصفتك منك كتابة بيان انعكاس ومرة أخرى قد تتم دعوتك لمشاركة ذلك مع الباحث. في نهاية الدورة، ستتم دعوتك أيضًا للمشاركة في استبيان الكفاءة الذاتية مرة أخرى. ستتم مقارنة النتائج قبل وبعد الدورة لتحديد ومقارنة أي تغييرات في نتائج الاختبار. هذه الدراسة مدعومة من جامعة فليندرز، كلية التربية وعلم النفس والعمل الاجتماعي.

:الغرض من الدراسة

:يهدف هذا المشروع إلى
.السعودية في استخدام التكنولوجيا في التدريس PSTs تقييم وقياس الكفاءة الذاتية لـ

لتكنولوجيا المعلومات والاتصالات بطرق مختلفة وكيف يقومون بتكييف تكنولوجيا المعلومات PSTs اكتشف كيفية استخدام .والاتصالات في التدريس قبل وبعد مشاركتهم في الدورة

.واستخدام التكنولوجيا، لا سيما في السياق السعودي PST فحص الروابط بين الكفاءة الذاتية لـ

ماذا سيطلب مني أن أفعل؟

.ستتم دعوتك للمشاركة في استطلاع قبل وبعد الاستطلاع لجمع البيانات حول الكفاءة الذاتية لمعلم ما قبل الخدمة •

أنت مدعو أيضًا للموافقة حتى تتم ملاحظتك أثناء درس التدريس المصغر والمقابلة فور الانتهاء من الدرس. ستستغرق المقابلة حيث سيُطلب من جميع Zoom ما بين 45-60 دقيقة. سيتم تسجيل صوت الملاحظة والمقابلة ومجموعة التركيز عبر تطبيق Flinders المشاركين إيقاف تشغيل الكاميرات الخاصة بهم. سيتم نسخ المقابلة وتخزينها كملف كمبيوتر على سحابة جامعة .مع الحماية بكلمة مرور

ما الفائدة التي سأستفيد منها من المشاركة في هذه الدراسة؟

في جامعات المملكة العربية السعودية، بالإضافة إلى PSTs ستساعد مشاركة خبراتك في تطوير التطوير المهني لإعداد في السياق السعودي وربما بشكل عام لبقية PSTs المساهمة في فهم كيفية حدوث تطوير تكنولوجيا المعلومات والاتصالات لـ العالم
..(سيُطلق من أجريت معهم المقابلات 40 دولارًا كتعويض عن وقتهم) •

هل يمكنني التعرف على هويتي من خلال المشاركة في هذه الدراسة؟

في حين أن الردود لن تكون مجهولة الهوية، لتمكين مطابقة البيانات عبر مجموعات البيانات، فإنها ستبقى سرية. بمجرد مطابقة البيانات، سيتم إلغاء تحديد هويتها للحفاظ على السرية. سيتم الاحتفاظ دائمًا بسرية اسمك وبياناتك الشخصية الأخرى. لن يسمح أي جزء من هذا المشروع البحثي بتحديد أي مشارك. سيتم تخزين جميع البيانات على سحابة الجامعة وتكون محمية بكلمة .مرور. ستكون معلومات المشروع متاحة فقط لاستخدام الباحث

هل هناك أي مخاطر أو مضايقات إذا كنت متورطًا؟

لا نتوقع أي إزعاج أو خطر ينشأ عن مشاركتك في هذه الدراسة. ومع ذلك، إذا شعرت بالضيق أثناء مشاركتك في المقابلة، فسيتم إحالتك إلى خدمة الاستشارة المجانية المقدمة لجميع موظفي وطلاب الجامعات. إذا كانت لديك أي مخاوف بشأن المخاطر

Figure F-7. Page 6 of consent form

المتوقعة أو الفعلية أو عدم الراحة، فيرجى طرحها مع الباحثة في البداية وسوف توصيك بالاتصال بخدمة الاستشارة المجانية أو يمكنك أيضًا الاتصال بالخدمات التالية للحصول على الدعم

مركز الاتصال 937 التابع لوزارة الصحة

كيف أوافق على المشاركة؟

المشاركة طوعية. يمكنك الإجابة على "لا تعليق" أو رفض الإجابة على أي أسئلة ولك الحرية في الانسحاب من المشاركة في الدراسة (في استطلاع / ملاحظة / مقابلة / مجموعة تركيز) في أي وقت دون عواقب سلبية. نموذج الموافقة مرفق بصحيفة المعلومات هذه. إذا وافقت على المشاركة، يرجى قراءة النموذج والتوقيع عليه وإعادته إلى الباحث أو من خلال استبيان Qualtrics. قد يتصل بك الباحث، إما عن طريق البريد الإلكتروني أو مكالمة هاتفية لترتيب موعد لتدريسك المصغر في وقت مناسب لكلا الطرفين.

السرية والخصوصية

يمكن فقط للباحثين المدرجين في هذا النموذج الوصول إلى المعلومات الفردية التي قدمتها. سيتم ضمان الخصوصية والسرية في جميع الأوقات. يمكن تقديم نتائج البحث في المؤتمرات أو كتابتها للنشر أو استخدامها لأغراض بحثية أخرى كما هو موضح في نموذج المعلومات هذا. ومع ذلك، ستكون جميع المعلومات الفردية غير قابلة للتعريف في أي منتجات بحثية.

لن يتم مشاركة أو استخدام أي بيانات، بما في ذلك مجموعات البيانات التي لا يمكن تحديدها أو التي لا يمكن تحديدها أو عدم التعرف عليها، في مشاريع البحث المستقبلية دون موافقة صريحة منك.

سيتم نسخ البيانات من قبل شركة خارجية للتحقق من الترجمه، في شكل غير محدد ، لمعلومات المشاركين..

مخزن البيانات

المحمي بكلمة مرور طوال فترة الدراسة. Flinders قد يتم تخزين المعلومات التي تم جمعها بشكل آمن على خادم جامعة سيتم إلغاء التعرف على أي بيانات يمكن تحديدها لأغراض تخزين البيانات ما لم يُذكر خلاف ذلك. سيتم نقل جميع البيانات لمدة خمس سنوات على الأقل بعد نشر النتائج. بعد فترة Flinders وتخزينها في جامعة Flinders بشكل آمن إلى جامعة تخزين البيانات المطلوبة، سيتم إتلاف جميع البيانات بشكل آمن وفقًا لبروتوكولات الجامعة.

كيف سأتلقى التعليقات؟

سيتم تقديم ملاحظات نسخ المقابلة إلى كل مشارك عبر البريد الإلكتروني للتحرير والمراجعة. سيتم تلخيص نتائج المشروع وتقديمها لك من قبل الباحث إذا كنت ترغب في رؤيتها.

أعلن تضارب محتمل في المصالح

هناك احتمالية لحدوث تضارب مصالح محسوس بسبب العلاقات التي قد تكون قد نشأت من خلال تفاعلات العمل السابقة. قد يخلق هذا التزامًا من جانب المشاركين ليشعروا بأنهم ملزمون بالمشاركة أو الإجابة بطرق تعرض البحث للخطر. سيتم التعامل مع ذلك من خلال (أ) في هذه الرسالة و (ج) في الرسالة.

موافقة لجنة الأخلاقيات

تمت الموافقة على المشروع من قبل لجنة أخلاقيات البحث البشري بجامعة فلندرز (4096).

الاستفسارات والمخاوف

يمكن توجيه الاستفسارات أو المخاوف المتعلقة بالبحث إلى فريق البحث. إذا كانت لديك أي شكاوى أو تحفظات حول السلوك الأخلاقي لهذه الدراسة، فيمكنك الاتصال بفريق مكتب الأخلاقيات البحثية والامتثال بجامعة Flinders على الهاتف +61 8 3116 8201 أو إرسال بريد إلكتروني إلى human.researchethics@flinders.edu.au.

Figure F-8. Page 7 of consent form

نشكرك على الوقت الذي قضيته في قراءة ورقة المعلومات هذه التي تحتفظ بها. إذا قبلت دعوتنا للمشاركة ، فيرجى التوقيع على نموذج الموافقة المرفق من خلال
Qualtrics

https://qualtrics.flinders.edu.au/jfe/form/SV_9TcacbSTihWPz2m

نموذج الموافقة

بيان الموافقة

قرأت وفهمت المعلومات المتعلقة بالبحث، وأدرك أنه طُلب مني تقديم موافقة مستنيرة للمشاركة في هذه الدراسة البحثية. أفهم أنه يمكنني الاتصال بفريق البحث إذا كان لدي المزيد من الأسئلة حول هذه الدراسة البحثية.

- ❑ **لست على علم بأي شرط من شأنه أن يمنع مشاركتي، وأوافق على المشاركة في هذا المشروع.**
- ❑ **أتفهم أن لي مطلق الحرية في الانسحاب في أي وقت أثناء الدراسة.**
- ❑ **إذا كان لدي أي شكاوى أو تحفظات Flinders أفهم أنه يمكنني الاتصال بمكتب الامتثال والأخلاقيات البحثية بجامعة حول السلوك الأخلاقي لهذه الدراسة.**
- ❑ **أفهم أن مشاركتي سرية وأن المعلومات التي تم جمعها قد يتم نشرها. أفهم أنه لن يتم تحديد هويتي في أي منتجات بحثية.**

أوافق كذلك على:

- ❑ استكمال الاستبيان
- ❑ ملاحظتي وانا اقوم بالدرس
- ❑ المشاركة في مناقشة مجموعة التركيز
- ❑ تسجيل معلوماتي الصوتية

المراجعة / الموافقة على نسخ الملاحظة والمقابلة

أنا المشارك الذي يظهر توقيعه أدناه، قرأت نسخة من مشاركتي في **الملاحظة والمقابلة** وأوافق على استخدامها من قبل الباحث كما هو موضح. 7.

توقيع المشارك..... التاريخ .....

تمت الموافقة على هذا المشروع البحثي من لجنة أخلاقيات البحث البشري بجامعة فلندرز (رقم المشروع 4096). للاستفسارات المتعلقة بالموافقة على أخلاقيات هذا المشروع البحثي، يرجى الاتصال بالمدير التنفيذي للجنة عبر الهاتف على رقم +61882013116 أو عبر البريد الإلكتروني human.researchethics@flinders.edu.au

Figure F-9. Page 8 of consent form