Graduate School of Education

Saudi Arabian Science and Mathematics Pre-service Teachers' Perceptions and Practices of the Integration of Technology in the Classroom

Submitted by

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I certify that all material in this thesis which is not my own work has been identified and that no material has previously been submitted and approved for the award of a degree by this or any other University.

Signature: ………………………………………………

Abstract

This study was conducted to explore the Saudi Arabian science and mathematics primary school pre-service teachers' perceptions and practices of the integration of technology in the classroom. As their practice takes place within two different institutions (University and school) each has its own policy and agenda, the complexity of their practice environment rises and the context might become problematic. Thus, both personal and contextual factors within these two institutions were explored to draw a whole picture of the issue according to the sociocultural theory as the theoretical framework of the study.

Case study was adopted as the research methodology using Technological Pedagogical Content Knowledge (TPACK) questionnaire, classroom observation and semi-structured interviews to collect both quantitative and qualitative data. The sample consisted of 15 participants; seven primary school pre-service teachers (science and mathematics), four university tutors and four head teachers.

Two different categories of the pre-service teachers were identified; users and non-users of technology. Interestingly, those who used technology were found to adopt traditional transmission strategy of teaching. They perceived strong agency assuming that their role is to transfer knowledge to passive learners through visual technology. In contrast, those who did not use technology assumed more active role by the pupils. Therefore, they thought visual technologies are not appropriate tools for a learner-centred strategy of teaching showing less awareness about the affordances that this type of technology could provide. Accessing guidance during teaching practice was found to be a significant element that could allow pre-service teachers to learn properly within their zone of proximal development and contribute considerably to their pedagogical identity development and their understanding of agency in the classroom. Moreover, teaching subject was found to be an important factor in shaping the pre-service teachers' identity and practice.

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Table of Content

List of Tables

List of Figures

List of appendices:

1 Introduction to the Study

1.1 Introduction

This chapter provides a discussion about the rationale of the study and the gap in the literature that it seeks to occupy. It also presents a brief description of the study's theoretical framework. The research significance and the research questions are also presented in this chapter. Moreover, an overview of the research design is discussed briefly in this chapter followed by this study's contribution to knowledge. Finally, it provides an outline of the thesis structure with some details about each chapter.

1.2 Rationale of the study and the literature gap

In today's society, Information and Communication Technology (ICT) plays a major role in individuals' lives as well as in institutions. As a result of this technological revolution and the rapid development of digital technology, there are increasing demands for employing technology in education to cope with the ever-growing amount of knowledge and to enhance teaching and learning. Although technology was introduced into primary schools many years ago, there seem to be unexplored factors that may encourage or discourage teachers in adopting technology and influence their perceptions and practices. This is especially the case in Saudi Arabia where the use of technology for teaching and learning in primary schools is demanded by policy-makers and substantial funding is provided every year to support the adoption of technology in classrooms. In addition, higher educational institutions and universities prepare pre-service teachers to make good use of technology in their teaching.

As will be shown in the literature review chapter (Chapter Three), there are increasing demands for the use of technology in educational practice around the world to enhance teaching and learning processes. Also, pre-service teachers seem to have positive perceptions towards the role of technology in education and they seem to be well-prepared in technological skills. In addition, technological equipment and resources seem to be available to some extent in schools. However, pre-service teachers only employ technology in the classroom at a relatively low level. This limited use could be influenced by many aspects in the educational environment.

From the literature review associated with the adoption of ICT among science and mathematics pre-service teachers, it is argued that most of existing studies focused on specific aspects related to the adoption of ICT by ‘in-service’ teachers. For example, research studying pedagogy related to ICT use found that pedagogical aspects are important and need to be developed if the integration of ICT is to be successful (Jung, 2005; Pineida, 2011; Webb & Cox, 2004). Other research concerns with teachers’ beliefs and attitudes towards the use of ICT in education and found that teachers’ beliefs are important for their adoption of ICT in the classroom. However, their beliefs seem to be influenced by many factors in the learning environment (Jiomyiannis and Komis, 2007; Kalogiannakis, 2010; Sime & Priestley, 2005). In addition, some research focused on professional development projects and their role in improving the use of ICT and found that teachers use ICT properly when provided with skills and resources (Lavonen, Juuti, Aksela & Meisalo, 2006; Postholm, 2007).

Fewer researchers have studied the use of ICT in education by pre-service teachers who are influenced by many factors that influence teachers’ perceptions and practices related to the use of ICT in the classroom, such as beliefs, prior experience of ICT use, availability of resources and equipment (Kaasila & Lauriala, 2012; Tezci, 2011). However, from the literature review, there seem to be many factors that influence the pre-service teachers' use in particular as they are engaged in a partnership environment between two institutions (university and school), each one has its own objectives, policies and agenda. Most research into pre-service teachers' use of ICT, as far as I am aware, focused on particular aspects related to their integration of technology. For example, some research (Sadaf, Newby & Ertmer, 2012) investigated pre-service teachers' beliefs about specific applications of technology in teaching and learning (Web 2.0) and did not consider the partnership community that the pre-service teachers are engaged in and its influence on their adoption of ICT. The wider context is also an important element that contributes to shaping the use of technology by pre-service teachers and their perceptions about it. All aspects within the teaching and learning context must be given sufficient attention when studying this issue in order to gain a deeper understanding about how their perceptions and practices are shaped. Another study in Turkey (Tezci, 2011) studied the use of ICT by pre-service teachers and focused on internal factors (such as beliefs and experience) and external factors (such as the school support), but also without consideration of the complex partnership setting and the social relationships and their effects. Notably, most research into the use of technology by pre-service teachers investigated the issue by focusing on very limited aspects within the context, missing considerable elements in the environment that have direct relationships with their use of ICT.

It can be argued that the complexity of the partnership environment between university and school and its influence on pre-service teachers' perceptions and practices related to the use of technology make it difficult to have a clear view about how their use of ICT in the classroom is influenced if the whole context is not taken into account. Therefore, ICT should be seen as a part of the learning environment and the community of the partnership between university and school, and the area of focus should include all the components of these interacting systems where individual's interact with others in a setting that consists of individuals, community, culture, traditions, and psychological and physical tools used to achieve intended outcomes according to the policies organising the activities (Engeström, 2009).

In short, there seems to be a lack of clarity in how perceptions and practices related to the use of technology in the primary school classrooms by science and mathematics pre-service teachers are influenced and shaped and about the factors that influence their adoption of technology within the complex environment of the partnership setting. This issue needs to be investigated, particularly, in Saudi Arabia where, as I am aware, there is a lack of research about the use of technology by pre-service teachers that takes into account the particular social and cultural aspects. Moreover, from my experience as a lecturer in the College of Education at the University of Hail in Saudi Arabia and as a tutor of pre-service teachers during their school placement for four years, I am aware that investigating this issue within this context is sorely needed due to the regrettable lack of use of technology by pre-service teachers. There is also a lack of clarity of the factors that shape their use of technology and their beliefs about it, such as university input, pre-service training support and the wider context.

1.3 Theoretical framework

The main purpose of the current study is to investigate Saudi Arabian mathematics and science pre-service teachers' perceptions and practices of the integration of ICT in the classroom in primary school and how their use is shaped within the study context. In order to gain deeper understanding about the issue under investigation in all its pedagogical, cultural and social aspects, sociocultural theory is adopted as the theoretical framework of the study. I believe that sociocultural theory allows one to look at the issue from multiple levels and that this can significantly contribute to existing knowledge about the integration of ICT into classroom activities. This should inform pre-service teachers, policy makers, teacher education programme designers and all people involved in the pre-service teachers' practice partnership. Within sociocultural theory, multiple frameworks (TPACK, the theory of planned behaviour, affordance theory, identity and agency) are integrated to organise the focus of the study and to highlight many aspects within the context that are related to the use of technology, such as the pre-service teachers' different forms of knowledge, their behavioural, normative, and control beliefs about the use of ICT in education, their identity and understand of agency, and how these aspects are formed and influenced in the light of sociocultural theory principles. I believe that this integration of multiple frameworks will significantly contribute to existing knowledge of the science and mathematics pre-service teachers' use of ICT in educational practice. However, it is worth mentioning that the theory of planned behaviour is not a leading theory in this study, rather, its ideas will be considered during the study stages in order to organise the focus on the pre-service teachers beliefs and to give insights into the different forms of belief and how they are shaped in the light of the sociocultural context. The TPACK framework is also used as a first phase of the study to provide insights into the pre-service teachers' knowledge and how they perceive their TPACK knowledge before I move on to the main phase of the study according to sociocultural theory. I believe that using these multiple frameworks as assistant frameworks to inform the focus of the study according the sociocultural lens is valuable and will provide better and deeper understand about the issue under investigation.

1.4 Research significance

The significance of this research emerges from the expected findings which could contribute to knowledge by providing information that supports educational development and teacher preparation. It could also provide policy-makers in Saudi Arabia with a clearer view and understanding of the implementation of technology in the education system. In addition, it could promote the development of universities' programmes by providing them with the actual needs of schools regarding teacher education.

1.5 Research questions

The study aims to explore the Saudi Arabian science and mathematics pre-service teachers' perceptions and practices related to the integration of technology in the primary school classrooms. It seeks to answer the following research questions:

- What is the science and mathematics pre-service teachers' perceived technological pedagogical content knowledge (TPACK)?
- What is the relationship between the science and mathematics pre-service teachers' perceptions and practices of the integration of technology in the classroom?
- What is the relationship between the science and mathematics pre-service teachers' experience with technology and their practices of the integration of ICT in the classroom?
- How does the school setting influence the pre-service teachers' perceptions and practices of the integration of technology in the classroom?

- How does the university setting influence the pre-service teachers' perceptions and practices of the integration of technology in the classroom?
- How does the partnership setting influence the pre-service teachers' perceptions and practices of the integration of technology in the classroom?

1.6 Overview of the research design

The study aims to explore the Saudi Arabian science and mathematics pre-service teachers' perceptions and practices related to the integration of technology in the primary school classrooms and to identify the key factors that influence their practice with regard to the use of technology in the classroom. The relationships between their identity development, their understanding of agency, and their recognition of technology affordances in the light of the sociocultural context of their teaching practice are examined in depth to provide insights into the pre-service teachers' practice related to technology and their perceptions about it.

Both personal (e.g. perceived knowledge, perceptions and experiences) and contextual factors (e.g. relationships with others) were explored to draw a whole picture of the issue under investigation. To answer the research questions, I adopted case study as my methodology as this allowed me to engage more with the context and to employ multiple methods in order to collect data from the participants. I used the TPACK questionnaire, classroom observations and interviews to collect both quantitative and qualitative data about the relationship between the science and mathematics pre-service teachers' perceptions and practices related to the integration of technology in the classroom and the influence of the practice context on their integration of technology. As a first phase, I distributed the questionnaire to all the science and mathematics pre-service teachers at the University of Hail who were taking their school placement during the second half of the academic year. Following the questionnaire that provided me with background information about how pre-service teachers perceived their knowledge related to the use of technology, I then carried out classroom observations and interviews with seven pre-service teachers. The sample included science and mathematics pre-service teachers, users and non-users of technology. This variety among the participants provided me with the opportunity to have a more comprehensive view of the issue and allowed me to conduct comparisons between these sub-groups of participants. This, in turn, has revealed many important findings related to the relationships between the pre-service teachers' perceptions and practices as will be shown in the findings and discussion chapters later in this thesis. In addition to the pre-service teachers, I interviewed university tutors and head teachers who supervise the pre-service teachers' school placement. This also has revealed many important findings from other points of view from those who are involved in the pre-service teachers training and seem to have an influential role on the pre-service teachers' development. Detailed information about the research design is presented in the methodology chapter (Chapter Four).

As mentioned, the study adopted sociocultural theory (in addition to its assistant frameworks) as its theoretical framework. The adoption of a theoretical framework is necessary to strictly guide the process of the study and limit its focus within the theory's scope, which could negatively affect the richness of data description in general (Braun and Clarke, 2006, p.83). This could occur, for example, when the themes are pre-determined deductively based on the theoretical framework principles. However, in order to both avoid the limitations of theoretical thematic analysis and take advantage of theory as a powerful tool to conduct research, open thematic analysis was conducted to code data inductively without fitting it into any pre-determined frame. However, the principles of sociocultural theory were considered and ‘kept in mind’ during the data analysis process which provided the opportunity for the data to speak for itself and keep the study in its right theoretical direction at the same time. Theoretical principles were applied more explicitly and intensively in the discussion chapter in order to interpret the findings which emerged from the open thematic analysis.

1.7 Contribution to knowledge

According to the study aims and objectives, and in the light of the study findings and discussion of these findings (Chapters Five to Eight), I may argue that the study provides significant contributions to theory and practice. These contributions might be implemented by teacher educators, universities, schools, and researchers in order to improve teacher education programmes and the partnership between universities and schools in relation to the use of technology in the classroom by pre-service teachers. It gives useful insights into their identity and agency development, their pedagogical knowledge development and their beliefs construction. These contributions are discussed in detail in the concluding chapter (Chapter Nine).

1.8 Structure of the thesis

The thesis is presented in nine chapters as follows:

Chapter One: introduction

Introduction chapter provides an overview of the study, its rationale, significance and research questions. It also provides an overview of the theoretical framework of the study and its research design. It suggests the contributions to knowledge that the study aims to achieve. It concludes with an outline of the structure of the thesis and its chapters.

Chapter Two: the study context

This chapter provides background information about the study context and its characteristics to offer the reader the contextual dimensions that contribute to shaping the study. The purpose of the study context chapter is to present general information about Saudi Arabia, its population, culture and educational system.

Chapter Three: literature review

This chapter reviews the relevant literature and it contains two main sections. In the first section, I review the literature related to the use of technology in education and explore the gap that this study attempts to cover. In the second section, I present the theoretical framework of the study and discuss how it could contribute to understanding the issue under investigation.

Chapter Four: methodology

This chapter presents a detailed description of the research methodology and design. The research objectives and questions are presented at the beginning of this chapter followed by the philosophical assumptions, research paradigm, ontology and epistemology. Then, the methodology of the study is presented including descriptions of sampling, research methods and instruments. Also, ethical issues and the procedure of data collection are presented, followed by the data analysis process and theoretical considerations related to the analysis. The research trustworthiness is discussed at the end of this chapter.

Chapter Five: quantitative findings

This chapter presents quantitative findings from the TPACK questionnaire. It reports findings related to the pre-service teachers technological pedagogical content knowledge (TPACK).

Chapter Six: qualitative findings (part 1)

This chapter presents the first part of the qualitative findings from the classroom observations and interviews. In this chapter I present findings related to personal aspects of the pre-service teachers such as perceptions and experiences.

Chapter Seven: qualitative findings (part 2)

This chapter continues presenting the qualitative findings related to the context and its relation to the pre-service teachers' perceptions and practices of the integration of technology in the classroom.

Chapter Eight: discussion

The aim of this chapter is, firstly, to present brief answers to the research questions from the study findings presented in the previous chapters (5, 6 and 7); and secondly examine the meanings of the main findings which emerged from the quantitative and qualitative data analysis in relation to the wider literature in the light of sociocultural theory as a lens that enables the findings' interpretation.

Chapter Nine: conclusion

This chapter concludes this thesis by presenting an overview of the study and its main findings. It discusses the study's contribution to knowledge including theoretical and practical contributions. It also discusses the study limitations and presents justifications for these limitations. Implications that are suggested by this study are also presented in this chapter including implications for policy makers, teacher educators and school staff who are engaged in pre-service teachers' school placement. I conclude the chapter with recommendations for further research and concluding remarks.

1.9 Summary of the chapter

In this chapter, I have discussed the rationale of the study and the gap in the literature that it seeks to cover. I have also presented a brief description of the study's theoretical framework, research significance and research questions. I then briefly presented an overview of the research design and the contribution to knowledge that this study aims to achieve. At the end of this chapter, I provided an outline of the structure of the thesis. In the following chapter, I will present information about the study context as these contextual aspects are very important in this study.

2 The Study Context

2.1 Introduction

This study explores the Saudi Arabian science and mathematics pre-service teachers' perceptions and practices of the integration of technology in the primary school classrooms. As "there is a strong link between culture and learning that is reflected in how people prefer to learn and how they tend to process information" (Samovar, Porter & McDaniel, 2009, cited in Alebaikan, 2010), it is therefore important to provide background information about the study context and its characteristics to offer the reader the contextual dimensions that contributed to shaping the study. According to Hamdan (2015), the demographic and cultural characteristics of a given community could significantly influence underlying assumptions that influence educational contexts including teacher education programmes. The purpose of this chapter is to present general information about Saudi Arabia, its population, culture and educational system.

2.2 General information about Saudi Arabia

The Kingdom of Saudi Arabia is located in the south west of Asia in the Middle East occupying more than two million square kilometres of the Arabian Peninsula as shown in the map (Figure 1.1) below. According to the Central Department of Statistics and Information in Saudi Arabia, the total population is 27.2 million; two thirds of these are Saudi citizens according to the 2010 census (CDSI, 2016).

Figure 2.1: Map of Saudi Arabia (https://www.google.co.uk/maps/)

Traditionally, Saudi Arabia is regarded as the homeland of Islam where the Prophet Muhammad proclaimed it in Makkah in the 7^{th} century and the country played an important role in the history of the Islamic Nation (Alnesyan, 2012). In its modern history, and before the discovery of oil in 1936, the country had a subsistence economy relying on limited natural resources such as farming, trading, and fishing in the coastal areas. After the oil discovery, its huge income was spent to develop the oil industry and the socioeconomic infrastructure. Many years later, and with the remarkable economic development supported by the oil industry, massive national development projects were performed in all sectors (Alsulaimani, 2010). Although Saudi Arabia (as the homeland of Islam and due to its desert life history) has a highly closed and conservative culture, its economic development has rapidly changed people's lives and oil industry income has supported many developments, including education and technology consumption (Hartley & Al- Muhaideb, 2007; Joseph & Lunt, 2006; Krieger, 2007; Nelson, 2010; Onsman, 2011; Ramady, 2010; Sutton, 2007, cited in AL-Zahrani, 2015).

2.3 Saudi Arabian Educational system

Saudi Arabia's formal educational system was founded in 1925 when the Directorate of Knowledge was established, supervising only four primary schools. Within a few years, the authority of the Directorate spread over the country to include 323 schools (Ministry of Education, 2016).

2.3.1 Ministry of Education

In 1954, the Ministry of Knowledge was established to take a more important educational role in planning and supervising general education in Saudi Arabia with its three levels (primary, intermediate and secondary). The educational system during this period was for male students only, until another educational system for female students was established in 1960. Many years later, the two authorities were merged under the umbrella of the Ministry of Education, in 2002 (Ministry of Education, 2016).

Currently, the Ministry of Education in Saudi Arabian is responsible for all aspects of schooling from the age of three to 18 years old through four main stages. The first stage is the pre-school stage which accepts children between three and five years old. However, enrolling in this stage is optional and is not a condition for the enrolment in the later compulsory education starting in primary school. The second stage is the primary school stage which takes children between six and 12 years old. By the end of primary school, children need to meet the requirements of the intermediate school through continuous assessment, leading to the Primary Education Certificate. The third, intermediate, stage lasts three years and takes children from 13 to 15 years old. In order to move to the secondary stage, children need to pass the examinations at all three sub-levels of the intermediate school to obtain the Intermediate Education Certificate. The last stage of compulsory education is the secondary school which also lasts three years, taking children from 16 to 18 years old. After the first year of this stage, student can choose a specialised path of study, either art and literature or science. Secondary school students need to pass all the three sub-level examinations in order to get the Secondary Education Certificate, which qualifies them to apply for the university programmes according to their specialised path in the secondary school (Alnesyan, 2012; Alsenaidi, 2012).

The Ministry of Education provides schools with the buildings, equipment, materials, textbooks and technology that are needed for educational and administrative purposes. It also sets general policies that are followed by the schools around the country (Alzaydi, 2010; Ministry of Education, 2011; Oyaid, 2009).

2.3.2 Ministry of Higher Education

The Ministry of Higher Education in Saudi Arabia was founded in 1975 to supervise universities around the country. It currently oversees 24 public universities in addition to eight private universities. The Ministry of Higher Education provides public universities with funds and general educational policies and allows them to establish their own programmes and internal organisation which need to be approved by the ministry. General higher education policies include undergraduate and postgraduate programmes times and credits. One of these policies is the organisation of teacher education programmes among the universities, such as the credits and the school placement period which takes place during the programme's last semester. It also encourages the adoption of technology in educational programmes (Ministry of Higher Education, 2015).

In 2015 the Ministry of Education and the Ministry of Higher Education were merged into one ministry (the Ministry of Education). The objectives of the new ministry are as follow:

1- Build Islamic, national and intellectual identity in relation to knowledge, skills and values.
2- Provide people with the opportunity to join general education.
3- Develop the criteria of teachers' qualification and improve their educational competences.
4- Raise the quality of education.
5- Expand provision of educational buildings and facilities and their maintenance.
6- Develop scientific research and knowledge and invest in them, and expand postgraduate programmes.
7- Expand private education in order to achieve its objectives.
8- Raise the quality of educational outcomes to meet the requirements of development and community needs.
9- Develop the regulatory environment and activate governance.
10- Provide overseas scholarships for distinguished students to meet the requirements of national development.
11- Invest in information and communication technology.
12- Diversify fund resources and investments.
13- Promote national and international partnerships (Ministry of Education, 2016).

2.3.3 Technology in Education in Saudi Arabia

In the Saudi educational system, there are increasing demands for effective integration of technology into educational practice and the government has paid more attention to this issue by providing substantial funding to many schemes that provide schools with technology and plan an up-to-date curriculum. Moreover, higher education institutions and universities attempt to prepare pre-service teachers by providing them with technological skills and the pedagogical implementation of technology through their courses and through pre-service training. This training takes place in schools regularly in the last semester of their BA degree under the supervision of tutors who visit them weekly over a period of approximately three months.

During recent years, the government has paid greater attention to the integration of technology in education. It has provided the majority of schools around the country with computer labs and technological equipment to be used in classrooms. All teachers are now required by policy to integrate technology into educational practice in a way that enhances teaching and learning. In addition, several national projects have been launched to promote the integration of technology in education. For example, a national project (Watani) was launched a few years ago to improve the use of computer networks in schools. This project's aims are as follows:

- To provide pupils with the skills to use ICT in education, thus preparing them for their future.
- To encourage the adoption of ICT by teachers in all educational activities.
- To provide an educational environment that is rich with information sources.
- To improve the outcomes of the educational system by instilling students with a good experience and skills in information technology.
- To encourage the creation of the information technology industry in the country.

- To increase awareness about the advantages of the integration of information technology in education and the benefits of this technology for the whole society (tatweer.edu, 2005, cited in Oyaid, 2009).

Furthermore, the King Abdullah Bin Abdulaziz Public Education Development Project (Tatweer) was launched in 2008 to review and develop the educational system and to give consideration to the integration of technology in education. It provides schools with new technology, focuses on teacher training in technology, and creates partnerships with universities to improve pre-service teachers' preparation for using technology effectively in schools (Tatweer, 2011). Although these national projects were launched to improve technology integration at schools, many studies show that the focus has been more on technological aspects (e.g. technological skills, technology equipment) rather than pedagogical applications of technology (e.g. Albugami & Ahmed, 2015; Al-Faki & Khamis, 2014; Alsulaimani, 2010). This could be a result of the ministry's concentration on quantity rather than quality, according to Al-Zahrani (2015). He added that this focus on technology itself more than pedagogy seems to negatively influence universities and prevent their programmes from carrying out important reforms related to the effective implementation of technology. Therefore, the current study is conducted as a response to this issue, aiming to widen the scope of the focus and consider sociocultural context and its relationship to the pre-service teachers' perceptions and practices related to the use of technology in the classroom. As the study is conducted at the University of Hail in Saudi Arabia as a case that could represent other universities in the region, in the next section, I provide some information about the University of Hail.

2.3.4 The University of Hail

The University of Hail was established in 2005 in the county of Hail in the north of Saudi Arabia under the supervision of the Ministry of Higher Education. It consists of 14 colleges, including the College of Education, which is the biggest college at the university in terms of the number of students (University of Hail, 2011). The College of Education provides many programmes that aim to prepare teachers in different subject areas and is responsible for their theoretical study for three years followed by school placement where pre-service teachers practice at schools for a whole semester. More information about the College of Education and its programmes related to technology are presented in the following section.

2.3.5 The College of Education at the University of Hail

The College of Education was established in 1983 under the supervision of the Ministry of Education as a teachers' college. This college became part of the university when the University of Hail was founded in 2005. It provides BA degrees in several areas. The college consists of eight departments: Islamic literacy, psychology, special educational needs, curriculum and teaching methods, educational technology, education, preschool, and home economics. Each of these programmes introduces modules that span seven semesters and include school placement during the last one (College of Education, 2011). Since the current study focuses on the pre-service teachers' use of technology in the classroom during their school placement, I present here an overview of their preparation in technology and the school placement system.

As part of all college programmes, the Educational Technology Department introduces six modules to provide students in all subject areas with the skills of using technology and instructional means. These modules provide the same contents to students in different areas of specialism (science, mathematics, religion …etc) where they study these modules in mixed groups that contain students from all these subjects together. These modules are described below in order to give background information about how the pre-service teachers at the University of Hail are prepared with technology (Educational Technology Department, 2010):

2.3.5.1 Education and Communication Technologies

Through this module, students are taught the development of education and its relationship with educational technology, communication theory, effective communication skills, the roles of teacher and pupils in the educational communication process, and the historical development of educational technology. Students are also taught the educational process according to the system approach, the relationship between instructional means and educational technology, classification of educational technologies and their importance in the teaching and learning process, and concepts related to implications of educational technology.

2.3.5.2 Producing and Using Instructional Means

In this module, students are taught the principles of designing instructional means and educational technologies and the stages of producing some of them. These technologies include educational graphics, educational painting, transparencies, educational photography, and designing sessions using PowerPoint software. In addition, this module introduces the principles and rules of using instructional means and educational technologies and the principles of using and employing technologies and software that are useful for education. Moreover, students are required to complete exercises and projects within this module.

2.3.5.3 Aural Means for Special Education

This module teaches students the importance and principles of educational radio; components of the radio studio; the concept, types, and preparation of radio magazine; some types of radio programmes (e.g., investigation and drama); concepts about radio work; live radio broadcasting; professionals in radio and their training; and radio production technology. Students are also taught through this module the aural means based on internet and their technology and the implications of computers in aural programmes. In addition, students complete exercises and projects related to aural means and radio programmes.

2.3.5.4 Educational TV Programmes for Children

Through this module, students are taught the principles and rules of TV programme production, the criteria of children's TV programme production, the components of the TV studio, and the principles of configuration for the subject that needs to be recorded. In addition, students learn about camera parts, camera movement, footage size, light, colour, and filter types, educational scenario preparation, TV programme staff members and their training, technologies and skills in preparing and producing TV programmes, and the criteria of educational TV programme evaluation. Moreover, students are required to perform practical exercises and projects within this module.

2.3.5.5 Education Technologies and Means (1)

The aim of this module is to teach students about the development of educational sciences and their relationship with educational technologies, the communication process, effective communication skills, and the role of teacher and pupils in the educational communication process. It provides students with background information about the historical development of educational technology, the educational process within a system approach, the relationship between instructional means and educational technology, classification of education technologies and means, examples of education technologies and means and their importance in educational practice, and concepts related to the employment of technology in educational practice.

2.3.5.6 Education Technologies and Means (2)

Through this module, students are taught the principles of educational technologies and means design and the stages of producing some of them, including educational graphics, painting, transparencies, and educational photography. Students are also taught how to design a whole session using computer software, the principles and rules of using education technologies and means, the principles of using and employing specialised websites and forums in education, and information about new technologies that can be employed in the educational context. Moreover, students are required to complete practical exercises and projects.

2.3.6 Teaching practice (School placement)

During the last semester of each programme, students undergo their school placement. Within this period of approximately three months, pre-service teachers practise teaching in schools under the supervision of university tutors and the help of head teachers and cooperating teachers who teach the same subject as that of the pre-service teachers. Objectives of school placement are as follows (drawn from the national guideline for teacher education programmes (Aleioni & Alfaleh, 2002)):

1- To provide pre-service teachers with practical experience that helps them to acquire professional skills and attitudes.
2- To provide them with practical experience that helps them to practice different educational activities.
3- To provide them with the opportunity to be familiar with the curriculum in the educational level they are preparing for.
4- To provide them with the opportunity to acquire initial teaching skills such as lesson planning, teaching methods, using educational means, producing educational means and classroom management.
5- To provide them with the opportunity to evaluate their abilities and their pedagogical knowledge.
6- To provide them with the opportunity to communicate directly with the pupils, teachers, and other school staff.
7- To familiarise them with the duties and responsibilities of teachers.
8- To provide them with the opportunity to perform different teaching strategies.

During the school placement, pre-service teachers are expected to meet specific standards according to the Practice Guideline. These standards are as follow:

1- Linking knowledge with real life phenomena through real life applications.
2- Using cooperative learning strategy of teaching to allow pupils to take control over their learning.
3- Using various forms of instructional means such as video films, images, presentation hardware and software, real models and samples.
4- Using instructional means that were previously produced by the pre-service teachers themselves during their university study prior to practice.

5- Dividing pupils into small active groups to perform practical activities.

In order to achieve the objectives of the school placement, pre-service teachers are supervised by university tutors, head teachers and cooperating teachers. Responsibilities within each role are outlined as follows (Aleioni & Alfaleh, 2002):

2.3.6.1 The role of university tutor

The university tutor is chosen from the university lecturers who hold at least a master's degree in curriculum and teaching methods to supervise and support pre-service teachers during their school placement for a whole term (half of the academic year). The tutor is expected to conduct field visits and weekly meetings during the pre-service teachers practice at schools. The university tutor's role is to perform the following:

1. Visit the pre-service teacher on at least eight occasions during the school placement, five of them in the classroom to observe the pre-service teacher's performance.
2. Draw the pre-service teacher's attention to various teaching methods and strategies.
3. Discuss the teaching plan with the pre-service teacher before the start of the lesson.
4. Meet the pre-service teacher individually after the classroom visit to provide him with the weakness and strength points in his performance.
5. Conduct weekly individual meetings with the pre-service teachers for at least two hours to discuss the possible difficulties that face them, show them video clips for ideal lessons, and help them in making instructional means and to evaluate their plans and activities.
6. Assess the pre-service teachers' performance continuously (Aleioni & Alfaleh, 2002).

2.3.6.2 The role of head teacher

The head teacher helps the university tutor in supervising the pre-service teacher in the administrative aspects such as explaining educational policy, school meetings, parents' meetings, lesson timetable, working hours, and school activities. The head teacher in the practice school is expected to perform the following tasks:

1- Familiarise the pre-service teachers with the school policies.
2- Introduce them to the school teachers and administrative staff.
3- Supervise their training hours at schools.
4- Enable them to engage in the school staff and parents' meetings.
5- Supervise their lesson planning on a daily basis.
6- Ensure their attendance at morning assembly and their punctuality at lessons.
7- Help them to participate in school activities.
8- Attend lessons with them from time to time.
9- Produce a report about their performance at the end of the term (Aleioni & Alfaleh, 2002).

2.3.6.3 The role of cooperating teacher

The cooperating teacher is chosen from school teachers who teach the same subject as the pre-service teacher. The cooperating teacher is expected to perform the following tasks:

1- Provide pre-service teachers with the module materials.
2- Familiarise them with the available instructional means and resources.
3- Familiarise them with any pupils with special needs.
4- Familiarise them with the pupils' characteristics and attitudes.
5- Train them to plan their lessons according to the weeks of the term.
6- Familiarise them with the school facilities, timetables, and resources.
7- Provide them with a space in the staff room.
8- Help them in writing their lesson plans.

9- Train them in dealing with the pupils' records and files.
10- Conduct weekly meetings to discuss their progress and any issues they might face (Aleioni & Alfaleh, 2002).

2.3.7 Standards related to the practice schools

The university regulation sets a number of standards that the practice schools need to meet:

1- Appropriate school building containing all necessary facilities and equipment such as labs, playground and gardens.
2- Readiness of the school to cooperate with the university and help in supervising the pre-service teachers and support their development.
3- The cooperating teachers in the practice school need to be highly skilled teachers (Aleioni & Alfaleh, 2002).

2.4 Summary of the chapter

In this chapter, I have presented background information about the study context where the contextual dimensions were argued to be powerful contributors to shaping the study. As the study took place in Saudi Arabia, I provided general information about Saudi Arabia. I also presented information about the Saudi Arabian educational system, giving information about the Ministry of Education, Ministry of Higher Education, and technology in Saudi Arabian education. I then provided information about the University of Hail and the College of Education where the current study took place focusing on the programmes and modules related to the use of technology by the pre-service teachers. I concluded the chapter with detailed information about the school placement system and the roles of the stakeholders within the partnership between university and school. In the following chapter, I review the relevant literature, address the gap that the current study seeks to occupy, and discuss the theoretical framework of the study.

3 Literature Review

3.1 Introduction

This chapter discusses the relevant literature of this study and is divided into two main sections: ICT in education and the study theoretical framework. In the first section, and in addition to presenting relevant definitions, I discuss teachers' and pre-service teachers' use of ICT in education in general regarding the reported benefits of ICT, skills needed for technology integration, and the role of context in shaping the adoption of ICT. I also discuss pedagogy and ICT use by pre-service teachers and the role of their various forms of knowledge (technology, pedagogy, and content) and their interactions in shaping their integration of ICT into practice in the light of TPACK framework. In addition, the pre-service teachers' beliefs about ICT in education and how these beliefs shape and are shaped by their practice regarding the use of technology are discussed. At the end of this section, I identify the gap in the literature that is explored by the current study in order to provide a better understanding of the Saudi Arabian mathematics and science pre-service teachers' perceptions and practices of the integration of ICT in the classroom and how their use is shaped during their practice.

In the second section of this chapter, I present the theoretical framework of the study, which is sociocultural theory, and discuss how it could contribute in understanding the issue under investigation.

3.2 ICT in education

In this section of the chapter I review the literature relevant to the study concerning the use of technology in the classroom by teachers and pre-service teachers.

3.2.1 What is ICT?

Today's world is changing rapidly under deep transformations that are driven and supported by Information and Communication Technology (ICT) innovations. These new technologies and applications have the potential to bring many advantages of the society in many different ways.

The term 'Information Technology' was firstly suggested in an article published in 1958 in the Harvard Business Review when the writers, Leavitt and Whisler, argued that "the new technology does not yet have a single established name. We shall call it information technology" (Leavitt & Whisler, 1958 p.41). Since that time, and during the development of technology and its applications, the term 'communication' which refers to the knowledge, skills, and equipment required to exchange information has been included in the notion of Information Technology giving the new notion of ICT. Under the wide umbrella of ICT, there are many sub-terms according to the intended field of study that draw attention to specific kinds of ICT, such as ICT in business, ICT in sports, and ICT in education.

The general term of ICT is a wide umbrella that covers all forms of communication equipment and applications. It includes all the computer hardware and software, network technologies, television systems, satellite systems, radio, mobile phones, and many other formats of technology. Information and Communications Technology (ICT) is defined as "a broad term that encompasses all forms of computer and communications equipment and software used to create, design, store, transmit, interpret and manipulate information in its various formats" (Queensland University, 2016, p.2). ICT was also defined by the U.S. Access Board (2011) as: "Any information technology, equipment, or interconnected system or subsystem of equipment for which the principal function is the creation, conversion, duplication, automatic acquisition, storage, analysis, evaluation, manipulation, management, movement, control, display, switching, interchange, transmission, reception, or broadcast of data or information. Examples of ICT are electronic content, telecommunications products, computers and ancillary equipment, software, information kiosks and transaction machines, videos, IT services, and multifunction office machines which copy, scan, and fax documents" (p.8). However, because of the rapid and constant development of technology, it is difficult to suggest an agreed definition of ICT.

Many types of communication and computer hardware and software are used in education in order to support and facilitate the teaching and learning process. Although there are various definitions of ICT in terms of its use in education, for the purpose of this research, I adopt the Teacher Training Agency (TTA) definition that ICT includes "computers, the internet, CD-ROM and other software, television, radio, cameras and other equipment" (Bennett & Leask, 2005, p.43). I adopt this definition because it includes all technological aspects that need to be focused on in this study and it covers all technologies that are used in schools by including computers and internet, software and hardware. I argue that computers and internet in this definition cover all information resources and communication applications that can be used in the classroom such as presentation software and multimedia. It also includes other types of equipment that may be used in the classroom such as TV and cameras. This definition looks at technology from an educational perspective that focuses on teachers' use of technology as suggested by Teacher Training Agency which makes it compatible with the focus of this study. Thus, when referring to the use of ICT in education in this research, it means the use of these forms of technology in the classroom to enhance and support teaching and learning processes.

3.2.2 The role of ICT for teaching and learning

In education there has been a great deal of debate about integrating ICT into everyday practice and the importance of using ICT in the classroom has been widely reported. However, many studies around the world report that using ICT in education does not necessarily improve teaching and learning processes (e.g. Anderson, 2008; Higgins, 2003; Koehler & Mishra, 2005; Pineida, 2011; Postholm, 2007) .It is reported that there are many aspects that need to be considered in order to make technology contribute positively to improving teaching and learning process. When studying teachers' use of technology in the classroom, their pedagogies, knowledge, and beliefs, in addition to the context where teaching and learning take place, need to be taken into account (e.g. Anderson, 2008; Pineida, 2011). These aspects are discussed in more detail later in this chapter. However, an overview of the role of ICT in education is presented here and findings from many studies regarding its value are discussed.

Pupils and technology

Technology is increasingly argued to be an important tool for primary education that significantly supports children's learning (Bird & Edwards, 2015; Nuttall, Edwards, Mantilla, Grieshaber & Wood, 2015).It is reported that using ICT in the classroom draws pupils' attention to what they are learning. Also it gives them the opportunity to learn in a more active fashion, allows access to up-to-date materials and uses video clips and images (Hammond et al., 2009). It is also argued that using ICT helps teachers and pupils in creating an enjoyable classroom environment which provides interactive communication that enables all pupils to participate in the learning process (Wegerif & Dawes, 2004). Jimoyiannis and Komis (2007, p.150) showed that "the use of ICT in education can increase students' motivation and deepen understanding, promote active collaborative and lifelong learning, offer shared working resources and better access to information, and help them to think and communicate creatively" (Jonassen, 2000; Webb, 2005)".

Policy-makers and technology

Furthermore, policy-makers around the world emphasize that using ICT in educational practice including networking, online materials, computer software and hardware that can be used to enhance teaching and learning should provide satisfying outcomes and should be beneficial for both teachers and pupils (Nykvist & Mukherjee , 2016; Ofsted, 2002; European Commission, 2004; Queensland Government, 2004; cited in Jimoyiannis & Komis, 2007, p.150).

Many years ago, the National Council for Educational Technology in the UK (NCET, 1994), which known later as the British Educational Communications and Technology Agency (BECTA), brought together findings of many research papers that highlighted the benefits of integrating ICT into the educational context, in order to make the advantages known to teachers, learners and parents. They reported that ICT has the potential to meet the individual pupil's needs and improve the abilities of every student. It encourages learners who do not enjoy learning to be more positive about it by providing them with the opportunity to achieve where they have previously failed to do. ICT also provide learners with immediate access to more resources and up-to-date materials.

This is beneficial not just for learners, but also for teachers who can access up-to-date materials about how they teach and how students learn. However, they reported that learners will not make effective use of ICT unless their teachers know when and how to integrate it. This raises the importance of preparing teachers pedagogically on how to integrate ICT into educational practice, which is discussed later in this chapter.

Technology development and its value for teaching and learning

As ICT has been rapidly developing since the 1990s, the value of ICT in education has also been increasing. The British Education and Communication Technology Agency (BECTA, 2001, cited in Bennett & Leask, 2005) documents reported many benefits of the use of more contemporary ICT in education. More recently, it is increasingly argued that the effective use of technology in the classroom environment could motivate children to learn, increase confidence and self-esteem, promote questioning skills and independent learning, improve presentation aspects, promote problem solving capability, and improve communication skills (e.g. Bennett and Leask, 2005; Bird & Edwards, 2015; Blackwell, Lauricella & Wartella, 2014; Nuttall et al.,2015; Nykvist & Mukherjee, 2016; Selwyn & Facer, 2014;). Bennett and Leask (2005) gave some examples of practices that gain these benefits among children. They indicated that ICT can enable children to test out ideas and present them in different ways for different audience and investigate and make changes in computer models. They also argued that children, with the help of ICT, can do things quickly and easily which might otherwise be tedious or time-consuming. In addition, it allows them to store and handle large amounts of information in different ways and communicate with others over a distance (Bennett & Leask, 2005). Many other studies from all around the world (e.g. Canada, USA, Singapore, China and the

Middle East) have reported many benefits that ICT provides for both pupils and teachers. For example, ICT was found to allow teachers to motivate pupils to learn, provide more opportunities for independent learning, produce creative learning environment, improve pupils achievement on tests and many other benefits that increase the quality of teaching and learning processes (e.g. Antony & Walshaw, 2009; Baek, Jung & Kim, 2008; Chai, Koh & Tsai, 2010; Fu, 2013; Ranasinghe & Leisher, 2009; Saba, 2009). Although technology was reported to be beneficial for teaching and learning in general by many researchers, others (e.g. Higgins, Xiao & Katsipataki, 2012) argue that the value of using technology depends on many aspects such as pedagogy, how technology is used, and its relation to what is being learned. So, it is the matter of 'how' rather than 'what' according to Higgins et al. (2012).

Technology for life

Through this practice, children develop capabilities of ICT use that are important for their development during school stages and later in their life by preparing them for the future (e.g. Fu, 2013; Ranasinghe & Leisher, 2009; Saba, 2009). BECTA defines the ICT capability as the "ability to use effectively ICT tools and information sources to analyse, process and present information, and to model, measure and control external events" (Bennett & Leask, 2005, p.51). Thus, the child capable in ICT is able to use ICT confidently, use information resources and ICT tools to solve problems, use ICT to support learning in a number of contexts, and understand the implications of ICT for working life and society.

From the above, it can be argued that there are many categories of reasons that make using ICT in educational practice important (Leask & Meadows, 2000). Firstly, political reasons in which the government wants all students to gain the necessary skills so their teachers should know and understand the importance of ICT skills which are needed by all in the modern information society. The second category is personal reasons where most adults in today's society, including teachers, use ICT in their personal lives for many different purposes. Another category is the pupils' needs, as the pupils live in homes that are very rich in ICT, such as computers, tablets and the internet, and they use them regularly with the help of their families. Moreover, the new curriculum design, for example in Britain, assumes the use of ICT and many resources are provided through the internet. In addition, and more importantly, pedagogical theories demand technology integration. Different teaching and learning styles and the variety of resources that facilitate pupils' learning should be taken into account in order to achieve effective teaching (Bird & Edwards, 2015; Instefjord & Munthe, 2016; Leask & Meadows, 2000; Nuttall et al., 2015). Pedagogical aspects of using technology in education are discussed later in this chapter.

Parents and technology

The importance of ICT in pupils' lives has also been emphasized by parents. Research (McNicol, Nankivell & Ghelani, 2002; O'keefe & Clarke-Pearson, 2011) have found that a large proportion of parents see the increasing use of ICT resources in schools and home as a positive development that enhance learning opportunities, socialisation and communications. McNicol et al. (2000) conclude that many parents think that their children would be disadvantaged if they could not access electronic resources. In the same study, many parents reported that ICT provides their children with the opportunity to achieve because it provides more information than books and that the child is more comfortable with ICT than with traditional resources.

Technological skills for the 21st century

In recent years, and as a result of the rapid development of technology, the value and benefits of ICT have become more important due to the emerging forms of technology that can promote effective teaching and learning, such as Web 2.0 technologies and social networking, which moves the role of student from being passive receiver to an active participant. The value of these technologies in education lies also in the students' needs to develop the skills of the 21st century that are important for everyone to succeed in today's society (Sadaf et al., 2012). Indeed, a strong motivation for teachers and the whole educational system to adopt these new technologies in education is the fact that the vast majority of today's pupils are very familiar with these applications as they are using them in their personal lives outside the school for many purposes, such as social communication and networking. The adoption of these applications is made much easier by building on the existing high level of familiarity, skills, and comfort of ICT use among students (Sadaf et al., 2012). Another motivation to integrate these technologies into educational practice is that they are free, or at least cheap, for users and easy to deal with (Butler, 2012; Sadaf et al., 2012).

Conditions need to be met

Although there is a wide range of literature that highlights the importance of ICT in daily educational practice, research (Postholm, 2007) has argued that several conditions must be met to make the use of ICT in education effective and for ICT to be regarded as an advantage, such as the maintenance of the equipment, teacher support, placement of the equipment and knowledge of software programmes. He found that the nature and circumstances of the lessons and the opportunities that ICT could provide, play a major role in the decision to use ICT. Further research (e.g. Almulhim, 2013; Alshehri, 2012; Cady & Rearden, 2007; Enochsson & Rizza, 2009; Jimoyiannis & Komis, 2007) found that the subject matter being learned could enhance or inhibit the use of ICT in the classroom depending on the benefits that ICT could provide. These arguments shed light on the importance of the social context where teaching and learning take place in shaping teachers' adoption of technology in addition to many other aspects such as their teaching subject and previous experience with technology.

3.2.3 ICT skills and teacher preparation

In the last few years, educational systems around the world have invested huge amounts of money and effort in providing and developing technology resources and training programmes. As a result of this investment, for example in England, most schools have been provided with the ICT equipment (hardware) and the educational applications (software) in order to promote and support teaching and learning processes (Bennett and Leask, 2005). Moreover, all teachers in all subjects and grades, according to Bennett and Leask, have been provided with the opportunity to engage in ICT training programmes in order to improve their personal and professional ICT skills and their abilities to use technology effectively. However OFSTED (2004b, cited in Bennett & Leask, 2005) and other studies (e.g. Harrison et al., 2003; Nuttall et al., 2015; Tezci, 2011) reported that using technology effectively to enhance and support teaching and learning processes is still low among teachers. This low use seems to be due to difficulties in getting access to technology resources among teachers (OFSTED, 2004a, cited in Bennett & Leask, 2005) and the lack of ICT skills and knowledge or in the skills of managing technology in practice and pedagogical aspects which is discussed later in this chapter (Instefjord & Munthe, 2016; Lavonen et al., 2006; Nuttall et al., 2015).

In the last decade, when technology became a more important part of educational practice and in order to promote the adoption of ICT in the UK, teachers need to pass an online ICT skills test before they engage in the field. They must show a high degree of knowledge on how to use technology in their subject teaching as well as in their professional development. Also, they must know how to provide their students with the opportunity to develop their skills in the use of ICT (Bennett & Leask, 2005). According to the ICT QTS skills test in England that used to be applied few years ago (Bennett & Leask, 2005) pre-service teachers needed to demonstrate a range of ICT skills in order to be qualified teachers. For example, they needed to develop general ICT skills such as choosing appropriate applications to promote problem solving, dragging and dropping, having multiple programmes open at a time, highlighting, and printing. Also they needed to demonstrate word processing skills, e-mail skills, database skills, web browser skills, and spreadsheet skills: finally, pre-service teachers needed to have presentation skills. Many other studies from all around the world also showed high policy-makers expectations of pre-service and in-service teachers to make good use of technology in the classroom and to create effective learning environments with the help of technology (e.g. Albugami & Ahmed, 2015; Lewis, 2015; Murley, Jukes & Stobough, 2013; Tatweer, 2011). Therefore, technological skills are reported in the literature to be a crucial part of the teachers' preparation which they need to develop before they engage in teaching practice at school. However, the nature of the preparation in technology and nature of skills needed by teachers to use technology effectively has been another subject of debate in educational research.

In Saudi Arabia, where the current study takes place, the integration of technology has been given great consideration and the preparation of teachers in technology has been given priority through national projects that aim to develop the educational system in the country including the integration of technology. For example, the King Abdullah Bin Abdulaziz Public Education Development Project (Tatweer) was launched in 2008 to review and develop the educational system and gave great consideration to the integration of technology in education through providing schools with new technology. It focused on teachers' training in technology and creating partnerships with universities to improve pre-service teachers' preparation for using technology effectively in schools (Tatweer, 2011). Although educational development national projects were launched to improve technology integration at schools, many studies show that the focus was more on technological aspects (e.g. technological skills, technology equipment) rather than pedagogical applications of technology (e.g. Albugami & Ahmed, 2015; Al-Faki & Khamis, 2014; Alsulaimani, 2010). Other recent studies (e.g. Al-Madani & Allaafiajiy, 2014; Mansour, El-Deghaidy, Alshamrani & Aldahmash, 2014) reported that the majority of teachers in Saudi Arabia were in need of pedagogical training related to the use of technology in the classroom.

3.2.4 Factors beyond the pure technological skills

From the above discussion, it seems that the integration of ICT into educational practice is seen as a priority in today's school and it is welcomed by a very wide range of researchers, policy-makers, teachers and pupils. Leask and Pachler (1999: xvii) stated that:

> *There is an enormous amount of political pressure on teachers to move swiftly to a position where ICT is integrated into their work in*

> *schools. Teachers around the world are feeling this pressure as governments divert funds to connect schools up to the web and to train staff.*

However, it is argued in the literature that, rather than technological skills, there are many factors that influence teachers’ adoption of ICT in their classrooms either positively or negatively, such as their beliefs about the role and importance of ICT in education, their teaching strategies and pedagogies, their teaching subject, their experience and skills in using ICT, in addition to the influence of the wider context and the social interactions and relationships within this context (e.g. Alenezi, 2015; Almulhim, 2013; Drijvers, 2012; Enochsson & Rizza, 2009; Hennessy et al., 2007; Mansour et al., 2014; Sime & Priestley, 2005). These issues are discussed separately in the following sections of this chapter.

It is argued that teachers’ attitude towards the use of ICT in education could significantly influence the implementation of technology in the classroom (e.g. Blackwell et al., 2014; Jimoyiannis & Komis, 2007). They also found that many factors could influence teachers’ attitude towards ICT as a teaching and learning tool. Research (e.g. Nuttall et al., 2015; Sime & Priestley, 2005) indicates that, although most teachers are positive about ICT, their actual use of it is relatively poor and limited to some basic applications. Moreover, the subject and gender of teachers have been thought to have a direct impact on teachers’ belief about the role of ICT in education. Jimoyiannis and Komis (2007) found that technology, science and foreign languages teachers have a strongly positive attitude towards ICT as a teaching and learning tool, while mathematics and social sciences teachers have a relatively negative attitude towards it. This finding sheds light on the significant influence of the teaching subject on shaping teachers’ beliefs and perceptions about technology and their practice and pedagogies. They also found that male teachers seem to have more positive beliefs about ICT than female teachers. This was supported by the findings of Kalogiannakis's (2010) study which reported that male teachers have a more positive attitude about ICT in education than female teachers. He also highlighted the age impact on teachers' perceptions about the adoption of ICT; he argued that younger teachers are more likely to adopt ICT in education than their older colleagues which was supported by Blackwell et al. (2014) and Camilleri and Camilleri (2016) arguments.

Regarding the age influence on teachers' belief and perceptions about ICT in education, Jimoyiannis and Komis (2007) reported different findings from those of Kalogiannakis and the others who claimed that younger teachers are more likely to adopt technology. They stated that teachers with more than 30 years of teaching experience have a more positive attitude towards technology in education than those who have from 20 – 30 years' experience, which raises a question that merits further investigation about the relationship between teachers, experience and perceptions about the role of technology in the classroom.

Cuckle and Clarke (2002) stated that teachers who have been teaching for some time may not always have sufficient ICT skills, which emphasises the importance of support and in-service training for teachers to be more confident in the integration of ICT in their teaching. Kalogiannakis (2010) also highlighted the importance of training not only for providing teachers with technological skills, but also for the effective pedagogical utilization of ICT.

From the above discussion, it can be argued that there are at least four factors that influence the use of ICT by teachers. The first factor is teachers' beliefs and attitudes towards the contribution that ICT can provide and the benefits and values of using technology in teaching and learning. Second is the teachers' experience and skills that they have and their ability to use ICT in the classroom and their training in ICT uses. In addition, the availability of resources and equipment at school such as computers, access to the internet and the ownership of computers at home strongly influence teachers' adoption of ICT in their teaching (Sime & Priestley, 2005). Community is also found to be an important aspect that can influence their use of technology. For example, teachers' membership in a network or group that provides needed support encourages their use of technology (Sime & Priestley, 2005).

In addition to the above factors that can influence the adoption of ICT, pedagogical aspects associated with the use of technology seems to play a vital role in shaping teachers' and pupils' beliefs about it. Research (European Commission, 2001, cited in Tezci, 2011) found that the adoption of ICT in education to support the traditional transmission strategy of teaching can negatively influence teachers' and pupils' attitudes towards the adoption of ICT in the classroom (Tezci, 2011). This was the case in Saudi Arabia where research (e.g. Alenezi 2015; Almulhim, 2013) reported that saving time and effort was the only motivator of the pre-service teachers to use technology in their teaching where they usually adopt a traditional transmission strategy of teaching. In addition, the separation between technological and pedagogical preparation was also reported widely in Saudi Arabia (Al-Madani & Allaafiajiy 2014; Almalki & Williams, 2012; Almulhim, 2013). This might have led to the poor adoption of technology among Saudi teachers despite the huge fund that the educational development projects provided (Albugami & Ahmed, 2015).

Therefore, teaching strategies and teachers' pedagogies are strongly related to how they adopt technology in their teaching. This highlights the importance of keeping teachers' pedagogies up-to-date through training alongside technological training courses in order to improve the use of technology and make it successful. The negative impression that results from using technology to support traditional transmission teaching strategies can justify the research findings that, although huge efforts and finance have been made to provide ICT in schools and prepare teachers to adopt it in their teaching, the use of ICT among teachers is still low (Lim, 2007; OECD, 2004; Tezci, 2011). This could indicate that integrating technology into educational practice is not enough to improve teaching and learning processes; rather, many other aspects need to be considered and developed in order to integrate ICT effectively into practice such as curriculum and teacher preparation. Pineida (2011, p.54) suggested a possible explanation of this issue, which is that "many nations have focused on providing ICT to schools without making an educational project that considers other factors that also impact the TLP [Teaching and Learning Process], besides ICT". This view coincides with Anderson's (2008) view based on many international studies that the introduction of ICT into the traditional educational system does not necessarily improve teaching and learning processes. Moreover, many Saudi studies (e.g. Al-Faki & Khamis, 2014; Almalki & Williams, 2012; Almulhim, 2013) reported that introducing technology as part of educational reform projects into school focusing only on the technology and technological skills of teachers has led to its low adoption among teachers. This means that there is a need to consider the educational system as a whole in order to successfully integrate ICT into practice. Pineida (2011, p.54) proposed that "in order to produce good quality learning using ICT, students should develop technological and learning competencies, and teachers should develop teaching, learning, professional, and technological competencies in order to make ICT improve learning outcomes". This should start in an early stage of teachers' preparation, particularly within teacher education programmes and pre-service training, taking into account the wider context and its influence in shaping the pedagogical culture in a given context.

This study is conducted to explore this gap in the literature regarding the science and mathematics pre-service teachers' perceptions and practices of the integration of ICT in the classroom. In order to understand how successful integration could be achieved and how the adoption of ICT and the perceptions about it are shaped, this study considers the whole educational context and looks at the educational system as a whole by widening the area of focus through the lens of sociocultural theory that considers the whole environment and its social interactions and relationships, as will be discussed later in this chapter in the theoretical framework section. In addition to the school setting as a focus of the study, the university setting is considered to capture as much information as possible about how the use of ICT by pre-service teachers is influenced and shaped during their teaching practice at schools.

3.2.5 Pre-service teachers and ICT use

Although there is a large body of literature that focuses on teachers' use of ICT in education and the factors that shape and influence their practice, fewer researchers have studied science and mathematics pre-service teachers' perceptions and practices regarding ICT use and the factors that influence their practice. Those available studies also seem to focus on limited aspects of the pre-service teachers' use of ICT such as the lesson context (Kaasila & Lauriala, 2012; Tezci, 2011). Therefore, exploring the issue with a wider focus to include many personal (e.g. beliefs and perceptions) and contextual aspects (e.g. relationship with others) would help in understanding how the science and mathematics pre-service teachers develop their beliefs about technology and how their pedagogies are shaped in the light of a given context. This wider area of focus can be seen as a unique context where the school placement settings and characteristic and the subject area of pre-service teachers could be important influential contextual factors that shape their perceptions and practices related to the use of technology in the science and mathematics classrooms.

3.2.5.1 Pre-service teachers' preparation for teaching with technology

Although pre-service teachers could be influenced by many factors that influence in-service teachers' perceptions and practices related to the ICT, such as prior experience of using ICT, the availability of resources and their belief about the role of ICT in education, there seem to be many factors that influence the pre-service teachers' perceptions and practices in particular. Research shows that the universities' input and the training of pre-service teachers during the school placement can be seen as major factors in their use of ICT (e.g. Cuckle & Clarke, 2002; Hammond et al., 2009; Instefjord & Munthe, 2016; Nykvist & Mukherjee, 2016; Usluel, 2007). While pre-service teachers seem to have sufficient technological skills gained from their courses and their personal lives, they show relatively poor access to computers and sometimes poor use of ICT in the classroom. Niess, Lee, Sadri and Suharwoto (2006) found that, while teachers show good technological skills, their use of technology was characterized as novice. This was because their skills were limited to technology operation rather than the integration of these technologies into teaching science and mathematics. A possible reason for this poor integration of technology among the pre-service teachers was indicated by Niess (2005, p.510) where “preservice teachers often learn about teaching and learning with technology in a more generic manner unconnected with the development of their knowledge of the subject matter”.

Some researchers argue that what pre-service teachers had learned in their courses was not always appropriate to what was available in schools (Cuckle & Clarke, 2002; Instefjord & Munthe, 2016; Nykvist & Mukherjee, 2016). Cuckle and Clarke (2002) argue that pre-service teachers need more support to overcome practical difficulties. This emphasizes the importance of preparing pre-service teachers to employ ICT within the pedagogical context and according to their teaching subject, as Kalogiannakis (2010) and Niess (2005) argued. This finding is supported by that of Wang (2001), that pre-service teachers might have a poor background regarding strategies of using ICT as a learner-centred tool. He concluded that higher educational institutions should develop programmes that address appropriate teaching strategies and the role of the teacher when teaching with ICT. This suggests that there is a mismatch, to some extent, between what pre-service teachers learn during their university study and what they face when they go to schools for teaching practice (Tearle & Golder, 2008 cited in Meredith, 2011). Another study (Enochsson, 2010) also supported this argument where it was found that “there is theory at the university and practice at schools and very little connection in between” (p.28). This sheds light on the importance of the university programme design and the partnership between the university and school regarding the organisation of the school placement of the pre-service teachers which is part of the focus of the current study.

Sime and Priestley (2005) also underlined the importance of preparing pre-service teachers in teaching strategies that are compatible with the schools' needs and the role of the teacher when teaching with technology which was supported by more recent research findings (e.g. Instefjord & Munthe, 2016; Nykvist & Mukherjee,2016). Sime and Priestley (2005) stated that "student teachers are now required to not only show good ICT skills, but also to be able to include ICT in their teaching in a manner which enhances children's learning" (p.132). From the above discussion, it is clear that higher educational institutions' input and pre-service training play a major role in shaping pre-service teachers' perceptions and practices related to ICT and the matters that need to be considered are not only technological matters, but rather pedagogical aspects and teaching strategies associated with ICT integration need to be considered carefully.

In addition, the importance of supporting pre-service teachers during school placements to use ICT effectively has been underlined by many researchers. Sime and Priestley (2005) summarized several aspects that need to be considered in order to improve the pre-service teachers' effective use of ICT. They argue that modeling of technology use by the pre-service teachers' tutors and cooperating teacher during school placements can help them to effectively integrate it into their practice. They also should be given the opportunity at university to use technology in their own learning and to apply the integration of ICT in teaching. Moreover, the availability of a community of people (such as teachers, university tutors and other pre-service teachers), which can offer support and guidance if needed, is important if the pre-service teachers are to develop the right perceptions and beliefs and to integrate ICT successfully (Sime & Priestley, 2005).

3.2.5.2 Teaching subject influence on ICT use: science and mathematics

The use of technology is appreciated and found to be valuable for both science and mathematics lessons. Hennessy et al. (2007) found that using technology, such as simulation, instead of real experiments with science lessons saves the teachers' time, provides them with more time to discuss the lesson contents that are demonstrated by technology and helps them to avoid practical issues that might face them when conducting real experiments. Technology, such as presentation technologies and dynamic applications, was also reported to be important for teaching and learning mathematics. Anthony and Walshaw (2009) argued that "these dynamic graphical, numerical, and visual technological applications provide new opportunities for teachers and students to interact, represent, and explore mathematical concepts" (p.157).

However, and as mentioned earlier in this chapter (3.2.4 Factors beyond the pure technological skills), the pre-service teachers' teaching subject was found to be an influential factor in their adoption of technology in their teaching. Research found that the use of technology among mathematics pre-service teachers was relatively low comparing with the science pre-service teachers (Almulhim, 2013). It was also reported that mathematics pre-service teachers complain about the lack of technological tools that support the learner-centred strategy of teaching (Enochsson & Rizza, 2009) which possibly contributes to the poor adoption of technology among them. On the other hand, science pre-service teachers were found to adopt more teacher-centred strategy of teaching than their mathematics colleagues (Almulhim, 2013; Alshehri, 2012; Cady & Rearden, 2007; Enochsson & Rizza, 2009). However, the underlying assumptions behind this difference in pedagogical identities of science and mathematics pre-service teachers do not seem to be explained and addressed well in the existing literature which the current study considers within its focus and attempt to explore.

3.2.5.3 The context of teaching practice

Furthermore, the wider context is an important element that seems to influence the implementation of technology in the classroom by the science and mathematics pre-service teachers and their perceptions about them. Around the world, the standards of training and assessment require evidence of using technology in the classroom, but there is very little evidence of the influence of such standards on pre-service teachers' practice (Hammond et al., 2009). Hammond and colleagues concluded that it was necessary to look "at the development of very good use of ICT in a more ecological manner; it is not the student teachers and it is not the environment, it is the interaction of the two" (p.71). In a separate study, conducted by Alenezi (2015) in Saudi Arabia, it was found that although teachers show an interest in using technology and they value its presence at school, their use was at a basic level and they show limited adoption of technology in the classroom. This was, according to Alenezi, because of the lack of administrative support and the lack of coordination and collaboration within the school context supporting the use of technology. The 'pedagogical culture' in any given context is also found to be an important element in shaping the pre-service teachers' adoption of ICT. For example, and particularly in Saudi Arabia, when the in-service teachers adopt the traditional transmission strategy of teaching without technology, and when this strategy becomes the 'culture of the school' which is a common culture in Saudi schools according to many studies, pre-service teachers seem to be influenced by this culture and find themselves driven towards adopting the same strategy or at least face the challenge of change (Alenezi, 2015; Al-Faki & Khamis, 2014;

Almalki & Williams, 2012; Almulhim, 2013; Alsulaimani, 2010). Thus, I may argue that the school context and its culture and tradition can be seen as an essential focus when the pre-service teachers' perceptions and practices regarding the use of technology are to be studied. Their relationships with the others within a given school context seem to be an influential factor that contributes in shaping their identities as science or mathematics pre-service teachers and forming their pedagogical perceptions and practices.

In summary, when studying science and mathematics pre-service teachers' perceptions and practices related to the use of technology in the classroom, it is important to look at many other aspects associated with their use. Pre-service teachers' pedagogies and teaching strategies are important elements that shape their adoption of ICT. Moreover, and in addition to technological skills, pre-service teachers need to develop other competencies such as learning, teaching, and professional competencies in order to be well-prepared to successfully integrate ICT into practice (Pineida, 2011). All these aspects seem to be influenced by the school context and culture where the wider context seems to have a direct relationship with their identity development and their pedagogies. This includes the expectations and support of people around them regarding their adoption of ICT, their beliefs about the value of technology in a particular context, and the influence of the other aspects in the environment such as the relationships with other teachers and pre-service teachers at school. It also includes the nature of the community and school setting where teaching and learning take place, cultural background of people who are engaged in this context, and policies regulating particular educational system. Moreover, pre-service teachers' practice teaching at schools in a partnership environment between university and school, each of them has its own objectives and policies which make the situation more complex. This raises the importance of considering the sociocultural context and its role in form the pre-service teachers' pedagogical concepts when studying the science and mathematics pre-service teachers' perceptions and practices regarding the use of ICT during their school placement.

3.3 Pedagogy and ICT

3.3.1 What is Pedagogy?

The term 'pedagogy' is a complex term that consists of many aspects relating to teaching and learning which makes it difficult to find a clear and agreed definition of pedagogy. However, there are many attempts to define pedagogy starting from the language dictionaries which define pedagogy as "the practice of teaching or the study of teaching" (Longman English Dictionary) or "the science of teaching" (Oxford English Dictionary). Alexander (2003, cited in Cogill, 2008) defines pedagogy as "the act of teaching together with its attendant discourse. It is what one needs to know, and the skills one needs to command in order to make and justify the many different kinds of decisions of which teaching is constituted". Alexander (1992, cited in Webb & Cox, 2004) identifies two faces of pedagogy; methods of teaching and student organisation.

From the above definitions of pedagogy, it can be argued that teachers' pedagogy shapes their teaching by leading them to specific teaching methods and their adoption of some educational practices according to the properties of the learning context. The use of ICT in the classroom among teachers and pre-service teachers is one of the aspects that is shaped and influenced by their pedagogies including their pedagogical beliefs, perceptions and values about the role of ICT in education and its contribution to teaching and learning process

(Webb et al., 2003). As ICTs are essential tools in today's society for the life generally and education specifically (Jung, 2005), teachers need visions of their potential, opportunities to use them, training and information update, and support in order to be confident in the use of technology and professional in how to apply ICT in the classroom properly. However, Jung (2005, p.94) argues that "combining new technologies with effective pedagogy has become a daunting task for both initial teacher training and in-service training institutions".

It is reported in the literature (e.g. Lavonen et al., 2006; OECD, 2004) that the use of ICT among teachers and pre-service teachers in most countries around the world, regardless their teaching subject, is limited to some basic applications and gaining information from the internet and only a minority use ICT applications regularly. This lack of ICT use is due to many reasons such as the lack of ICT skills and knowledge, problems relating to lesson time management, and difficulties in the integration of ICT into the classroom activities. The last reason is related to teachers' pedagogical assumptions, which makes them feel unprepared to use ICT in their teaching due to a lack of professional development and a shortage of trainers and technology supporters (Lavonen et al., 2006). Tezci (2011) also reports another pedagogical issue related to the use of ICT. He argues that pre-service teachers and in-service teachers need to learn not only how to adopt ICT to enhance and support traditional teaching strategies, but also to learn how to integrate ICT into classroom activities and how to identify its affordances and potentials according to the learner-centred perspective in order to enhance and promote the pupils' learning.

3.3.2 Affordance theory

The notion 'affordance' was first introduced in 1966 by the perceptual psychologist James Gibson (Brown, Stillman & Herbert, 2004). When he was analysing the animal environment, Gibson claimed that

> *The affordances of the environment are what it offers the animal, what it provides or furnishes, either for good or ill. The verb to afford is found in the dictionary, but the noun affordance is not. I have made it up. I mean by it something that refers to both the environment and the animal in a way that no existing term does. It implies the complementarity of the animal and the environment (Gibson, 1986, p.127).*

Although Gibson thought that the affordance results from a complementarity of animal and environment, he claimed that the affordances of an environment are "in a sense objective, real, and physical, unlike values and meanings, which are often supposed to be subjective, phenomenal, and mental" (Gibson, 1986, p.129). However, he did mention that affordances could be seen as objective-subjective properties and that these properties depend on both the environment and the observer behaviour. These properties, according to Gibson, or 'offerings' as he sometimes called them, are always there in the environment and could be 'or not be' discovered by the observers whose behaviour depends on their perceptions about the environment. Therefore, different observers might look differently at the same affordance according to Gibson as can be seen in the following extract (Gibson, 1986, p.133):

> *The fact that a stone is a missile does not imply that it cannot be other things as well. It can be a paperweight, a bookend, a hammer, or a pendulum bob. It can be piled on another rock to make a cairn or a stone wall. These affordances are all consistent with one another. The differences between them are not clear-cut, and the arbitrary names by which they are called do not count for perception. If you know what can be done with a graspable detached object, what it can be used for, you can call it whatever you please.*

However, Gibson tended to adopt the idea that affordances are more objective and are always there in the ‘one’ environment that contains multiple observers who might or might not perceive these affordance. Observers with different needs and perceptions about the environment would look at the object from a different point of observation (Gibson, 1986, p.11). This ambiguity in Gibson’s notion of affordance in terms of its subjectivity vs. objectivity has been debated by many researchers, especially those who look at it from an educational point of view (e.g. Brown et al., 2004; Chemero, 2003; Haines, 2015; Krauskopt, Zahn, Hesse & Pea, 2014).

Chemero (2003) argues against Gibson, claiming that affordances are not properties in the environment but, rather, they are relationships between the abilities of the observers and features of environmental situations. However, if the affordances are relationships between the observers and features of situation, how they are perceived? In this regard, Chemero (2003) states that affordances can be seen as placing these features of environmental situations and seeing what activities are allowed by them.

In educational research, the notion of ‘affordances’ arose few years ago when researchers started studying what the environment could offer teaching and learning processes. It has been used particularly when studying technological tools and their relationships with educational practice (Brown et al., 2004). However, Gibson’s affordance was developed within the educational literature to include the important role of culture and context in forming the idea of affordances. Tanner and Jones (2002 cited in Brown et al., 2004, p.122) defined the affordance as “a potential for action, the capacity of an environment or object to enable the intentions of the student within a particular problem situation”. Therefore, the interactions between students and technological tools, according to Brown et al. (2004, p.122), “necessarily involve both the ability of the learner and the affordance of the technology. These combine to determine the potential of the interaction in any given situation”.

It is clear that this view of affordance focuses on the relationships between learners and technology which form perceptions about the affordance. However, some researchers have focused more on the relationship between teachers (as agents of change) and technology as a determinant factor of technology affordances perception for both teaching and learning (Haines, 2015). She argues that teachers’ ability to recognize and identify the new tools’ affordances is an important element of their learning how to teach and their identity. Thus, affordances can be seen as relationships between teachers and technological tools, and definitely not just about the tools themselves, which is consistent with Chemero’s (2003) ideas about affordances, as explained earlier in this section. Given the importance of culture and context in forming perceptions about affordances, Haines (2015, p.166) defined an affordance as “the potential that teachers perceive in a particular technology tool that will support learning and teaching activities in their educational contexts”. Therefore, the teacher’s identity that is formed in a specific educational context contributes significantly to their perceptions about affordances of technology and their students’ perceptions about this technology and its role in teaching and learning. It depends, according to Haines (2015), on the nature of the relationships that teachers want to establish with their students and the role of each of them in the teaching and learning processes.

In this regard, Krauskopf et al. (2014) argue that a crucial challenge face pre-service teachers when moving to practice is how to move from the role of learner into the role of teacher. As pre-service teachers during their university study have a particular type of experience with technology as learners, this experience might not be the appropriate one to apply when using technology professionally in the classroom (Krauskopf et al., 2014). The findings of their study, which is consistent with literature presented earlier in this chapter, show that pre-service teachers focus more on their own use of technology, not the students' use, by adopting a traditional transmission strategy of teaching. The pre-service teachers' use of technology was for purposes like presenting, editing and attention direction. Therefore, perceiving the affordances of technology among pre-service teachers seems to be strongly connected with their pedagogical knowledge and their professional identity and agency.

3.3.3 Pre-service teachers' knowledge of teaching with technology

It can be clearly argued that the mere introduction of ICT to educational practice does not necessarily lead to successful ICT integration or improvement of the teaching and learning process (Anderson, 2008; Koehler & Mishra, 2005; Pineida, 2011). Pre-service teachers' technological knowledge has complex relationships with the other forms of knowledge that influence, and are influenced by, each other. Niess (2005) sees the preparation of science and mathematics pre-service teachers in these overlapping forms of pre-service teachers' knowledge as a challenge for teacher education programmes. He stated that (2005, p.510)

> *The challenge for teacher preparation programs is to prepare their candidates to teach from an integrated knowledge structure of teaching their specific subject matter—the intersection of knowledge of the subject matter with knowledge of teaching and learning, or pedagogical content knowledge (PCK) characterized by Shulman (1986). But, for technology to become an integral component or tool for learning, science and mathematics preservice teachers must also develop an overarching conception of their subject matter.*

It is not the matter of teaching teachers to teach with technology according to Niess, rather, it is the applications of these technologies in specific teaching subjects that need to be considered by teacher education programme designers paying more attention to the intersection between various forms of knowledge related to the use of technology according to a specific teaching strategy in a specific teaching subject. However, in many teacher education programmes, it is very common that pre-service teachers learn about the use of technology in the classroom in a generic manner with no, or at least weak, connection with the teaching subject matter (Niess, 2005). More recently, Niess admits, there has been a shift to incorporating these forms of knowledge within teacher education programmes and more consideration has been given to the pre-service teachers' complex knowledge development. Therefore, technological knowledge is no longer seen as the most relevant form of knowledge to the integration of technology in the classroom. Rather, their pedagogical knowledge, their subject knowledge, in addition to technological knowledge and the complex relationships between them seem to influence (and be influenced by) the pre-service teachers' perceptions and practices. Koehler and Mishra (2005, p.132) view "teacher knowledge about technology as important, but not separate and unrelated from contexts of teaching i.e., it is not only about what technology can do, but also, and perhaps more importantly, what technology can do for them as teachers". In the next part of this section, these forms of knowledge and their relationships in relation to the pre-service teachers' use of technology are discussed in more detail.

3.3.3.1 Pedagogical knowledge

The pre-service teachers' pedagogical knowledge plays a major role in shaping their teaching professionalism. Pedagogical knowledge is defined as "how to represent knowledge to younger learners and how to engage them in making conceptual connections by drawing on appropriate sources of information or evidence" (Rogers, 2006, p.17). It is also defined as "deep knowledge about the processes and practices and methods of teaching and learning and how it encompasses, among other things, overall educational purposes, values, and aims" (Mishra & Koehler, 2006, p.1026). Mishra and Koehler argued that pedagogical knowledge is a generic type of knowledge that deals the classroom management, lesson planning, students' learning and evaluation. Therefore, a pre-service teacher who gains deep pedagogical knowledge should be able to understand how students construct knowledge, how they acquire skills, and how they build positive habits and dispositions toward learning (Koehler, 2011). The pre-service teachers' pedagogical knowledge needs to be considered during teacher education programmes and their teaching practice at schools, with more consideration given to the pre-service teachers' epistemological views of teaching. This, as Rogers (2006) argues, raises a question about the design of the pre-service teachers' practice and its value in challenging their preconceptions about what learning to teach should involve.

Furthermore, the pre-service teachers' pedagogical knowledge depends on many aspects in addition to the formal subject content such as "a keen sense of the social and cultural community in which learning takes place; an intuitive sense of opportunity for challenging learners; sensitively tuned language; freedom and space to express personally constructed ideas" (Rogers, 2006, p.17). The emerging problem here is that these qualities of pedagogical knowledge are often incompatible with the structured nature of teacher education programmes and school policy and their agendas. The pre-service teachers' pedagogical knowledge is strongly influenced by being observed according to specific criteria within a structured model in both the university and school settings (Rogers, 2006). This sheds light on the nature of the pre-service teachers' identity development and their understanding of their agency, how they look at themselves and their roles under this complex setting. This complexity in learning environment makes it difficult to have a clear view about how the science and mathematics pre-service teachers' perceptions and practices related to ICT use in the classroom are influenced and how their adoption of ICT is shaped, which the current study attempts to explore through its multiple theoretical frameworks.

3.3.3.2 Content knowledge

Content knowledge refers to the form of knowledge about the pre-service teachers' actual subject that is to be taught such as history, science, mathematics or languages (Mishra & Koehler, 2006). Pre-service teachers' need to gain deep content knowledge in their teaching subject including all its concepts, facts, theories, its frameworks that organise and connect ideas, and all other aspects related to the subject (Shulman, 1986, cited in Koehler, 2011). Pre-service teachers' teaching subject seems to contribute in shaping their perceptions about teaching and learning and their practice. For example, the use of ICT by pre-service teachers and their beliefs about the value of ICT in education are found to be different according to their teaching subject (e.g. Cuckle and Clarke, 2002; Jimoyiannis & Komis, 2007). This can be related to their pedagogies that are influenced by their teaching subject. Therefore, these two domains of knowledge, pedagogical and content, should be considered together when studying educational practice of pre-service teachers.

3.3.3.3 Pedagogical content knowledge

Pedagogical content knowledge was an idea introduced by Shulman (1987) and was of special interest because “it represents the blending of content and pedagogy into an understanding of how particular topics, problems, or issues are organised, represented, and adapted to the diverse interests and abilities of learners, and presented for instruction” (Shulman, 1987, p.8). He argued that teachers’ pedagogical knowledge and their subject (content) knowledge were dealt with as two separate domains which led to the focus on subject aspects or pedagogy in teacher education programmes. In order to address this issue, Shulman suggested the idea of ‘pedagogical content knowledge’ to consider the importance of the relationships between pedagogy and content forms of knowledge. It can be argued that preparing a teacher with a strong subject knowledge and general pedagogy is important, but not enough for preparing a good teacher (Shulman, 1986). Therefore, pedagogical content knowledge was introduced at the intersection of content and pedagogy to go beyond the consideration of content and pedagogy as exclusive domains (Mishra & Koehler, 2006).

Although Shulman’s notion of pedagogical content knowledge was accomplished with a description of many other categories of teachers’ knowledge, such as curriculum knowledge, knowledge of learners, and educational context (Shulman, 1987), he did not explicitly mention technological knowledge and its relation to pedagogy and content.

In order to make ICT contribute to directing the pre-service teachers’ preconceptions about teaching and learning processes, it should be, from an early stage of their preparation, introduced as a powerful tool and its power lies in its pedagogical design. It should not be dealt with merely as a bank or a source of information and materials. However, the pre-service teachers' engagement with ICT "does not start with the technology itself, learning design nor, least of all, with theoretical perspectives on the adoption of technological applications. Instead, it is an iterative journey whose departure point is the subject context and its intellectual or professional properties within which the practitioner [pre-service teachers] resides" (Rogers, 2006, p.17). Thus, the pedagogy of ICT needs to be considered within a wider framework of the educational practice which goes beyond what is observed in the classroom to include the wider context. This should consider the pre-service teachers' beliefs and values about the role of ICT in education, their thinking and ideas that drive them to the observable behaviour in the classroom (Bird & Edwards, 2015; Nuttall et al., 2015; Webb & Cox, 2004).

When studying the science and mathematics pre-service teachers' perceptions and practices of the integration of ICT in the classroom, the affordance of the whole environment, including beliefs about ICT, needs to be considered. During the pedagogical reasoning process, and from an early stage of lesson planning, pre-service teachers need to choose appropriate resources and methods that are suitable for the lesson objectives, taking the affordance that these resources and methods offer teaching and learning process into account (Webb & Cox, 2004). Therefore, ICT should be seen as a part of the learning environment and the community of practice which cannot be studied separately from the cultural context where the learning takes place (Krumsvik, 2005).

The notion of pedagogical content knowledge introduced by Shulman was extended by Mishra and Koehler (2006) to pay more explicit attention to technological knowledge and its relationships with pedagogy and content. They asserted that the intent of their extended model is to “bring explicit attention to these issues by considering how technology interacts with pedagogy as Technological Pedagogical Knowledge (TPK), with content as Technological Content knowledge (TCK), and jointly as Technological Pedagogical Content Knowledge (TPCK)” (Koehler, 2011) which was changed later to TPACK for easier pronunciation.

3.3.3.4 Technological Pedagogical Content Knowledge (TPACK)

Although Shulman’s notion of pedagogical content knowledge is still valid and widely used in educational research, since 1980s, technology has come to the primacy of educational practice due to the availability of new technology and the need of teachers to know how to take advantages of this new technology and its affordances to successfully integrate it into practice. This has demanded a need for models that pay more attention to technology in particular and its integration into teaching and learning processes. These kinds of models are needed because technology knowledge seems to be considered separately from the other forms of knowledge when studying its implementation in education (Koehler, 2011).

Technological Pedagogical Content Knowledge (TPACK) is a framework that was introduced by Mishra and Koehler (2006) based on Shulman’s idea of PCK to explicitly consider technological aspects in education and the complexity of ICT integration into educational practice. It identifies “the nature of knowledge required by teachers for technology integration in their teaching, while addressing the complex, multifaceted and situated nature of teacher knowledge” (Koehler, 2011, np). Diagrammatically, their model of TPACK is represented as in Figure (3.1) below. This representation highlights the connections and interactions between these three forms of knowledge; technology, pedagogy and content in which the integration of technology into practice is shaped by the affordance that is provided by their interaction.

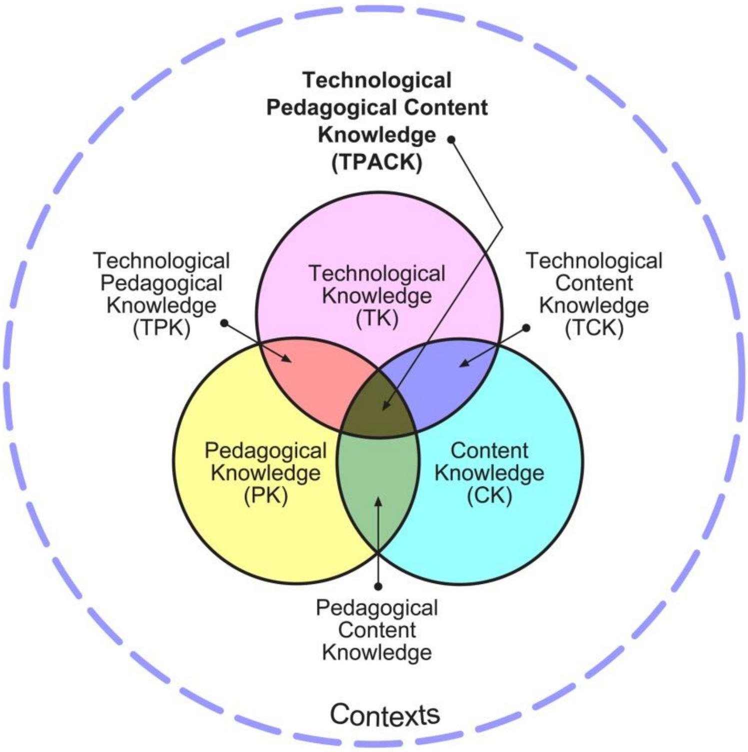


Figure 3.1: Technological Pedagogical Content Knowledge (Koehler, 2011)

This representation of TPACK goes beyond considering these forms of knowledge separately. It considers pedagogy and content together to get Shulman's idea of Pedagogical Content Knowledge (PCK). Also, it considers technology and content together to get Technological Content Knowledge (TCK). In addition, considering technology and pedagogy together gives the Technological Pedagogical Knowledge (TPK). At the intersection of technology, pedagogy, and content, is the Technological Pedagogical Content Knowledge (TPACK) (Koehler, 2011). From this perspective, successful integration of technology into educational practice requires deep understanding and careful consideration of the relationships, interactions, affordances and constraints between technology, pedagogy, and content forms of knowledge (Koehler, 2011; Mishra & Koehler, 2006).

I may argue that TPACK framework can be a useful lens to understand the pre-service teachers' technological, pedagogical, and content knowledge, and their interaction, and how this shapes and influence their ICT integration strategies in the classroom. TPACK framework has recently been adopted in research to discover aspects such as the nature of the relationships between these three forms of knowledge, the interaction between them, and issues that emerge from the integration of ICT (Angeli & Valanides, 2009; Cox, 2008; Archambault & Barnett, 2010; Graham, 201 cited in Pamuk, 2012). However, there seems to be only limited literature investigating the science and mathematics pre-service teachers' perceptions and practices of the integration of ICT in the classroom with the consideration of the TPACK notion. For example, Pamuk (2012) investigated how pre-service teachers with limited knowledge in any form of knowledge (technological, pedagogical, or content) use technology and how this influences the overall use of technology in the classroom. Studies (e.g. Koh, Chai & Tsai, 2013) which investigated these forms of knowledge and their relationships among pre-service teachers have provided quantitative results concerning their knowledge and their use of technology according to the TPACK framework.

Although TPACK is a useful framework in studying the pre-service teachers' use of technology by considering the interaction of their different forms of knowledge and can provide valuable insights into their ICT integration, it seems that many other aspects need to be considered if their adoption of ICT is to be better understood. I believe that the pre-service teachers' personal beliefs and values, in addition to their knowledge focused on by TPACK, should be taken into consideration as they play a major role in shaping their use of ICT in the classroom.

Shulman (1987) argues that pedagogical reasoning can be taught as it focuses on teaching processes that include the transformation of knowledge to learners. In his model of pedagogical reasoning, Shulman focused on knowledge and eliminated the role of personal beliefs and values about the process (Webb & Cox, 2004). However, research shows that the pre-service teachers' beliefs about ICT in education play a major role in shaping their adoption of ICT (e.g. Sime & Priestley, 2005). Webb and Cox (2004) expanded Shulman's model of pedagogical reasoning to include beliefs and values about the use of ICT in education. They introduced 'affordance' that ICT offers to the expanded version of the model which refers here to what ICT can offer people who are engaged in a learning environment. They identified "knowledge of affordances of ICT and decisions about their use as an addition to the pedagogical reasoning process" (Webb & Cox, 2004, p.238) when teachers and pre-service teachers engage in a learning environment that involves ICT use.

From the above discussion, it can be argued that pre-service teachers' thinking and beliefs about the role that ICT plays in education are strongly linked to their practice and the way they adopt technology in the classroom. Researchers, (Lavonen et al. 2006; Sadaf et al., 2012; Webb & Cox, 2004), among others, indicate that beliefs and values about the importance of ICT in education and the affordances it provides are major factors that influence the pedagogical practice relating to ICT use among pre-service teachers. It is also argued by Lavonen et al. (2006) that several aspects can shape and influence the pre-service teachers' use of ICT in education such as "educational policy, curriculum design, professional development and the development of pedagogical study materials" (p.161). These aspects emphasise the importance of the learning environment components in shaping the integration of ICT into classroom activities among pre-service teachers. It is also argued, from the sociocultural point of view, that the learning context is an essential aspect that needs to be considered when studying the pre-service teachers' adoption of ICT in the classroom and the focus should include the interacting systems of university and school where individuals develop relationships with others in an environment (Engeström, 2009). The focus on these social interactions and relationships within the teaching practice settings could draw the attention to the role of these aspects in shaping the pre-service teachers' identity and their understanding of the nature of their roles at schools as science and mathematics teachers.

3.4 Pre-service teachers' beliefs about ICT use

Teachers' beliefs can be defined as "tacit, often unconsciously held assumptions about students, classrooms, and the academic material to be taught" (Kagan, 1992, cited in Sadaf et al., 2012, p.938). Teachers beliefs, as argued earlier, strongly influence their integration of ICT into classroom practice which, as emphasised by the International Society for Technology in Education (ISTE, 2008, cited in Sadaf et al., 2012), requires teachers to develop up-to-date knowledge and skills of ICT pedagogical use to enhance the students' learning.

Nowadays, pre-service teachers can be seen as professionals in the use of new ICT such as social networking. However, they seem to be unprepared in integrating these technologies into the classroom practice. It is suggested that their pedagogical beliefs plays a major role in their successful use of ICT in the classroom (Blackwell et al., 2014; Ertmer, 2005; Lemon & Garvis, 2016; Sadaf et al., 2012). Thus, in order to promote the successful use of ICT in the classroom among pre-service teachers, their beliefs about it should be developed during their university study and school placement (Anderson & Maninger, 2007; Smarkola, 2008; cited in Sadaf et al., 2012; Lemon & Garvis, 2016). Mansour (2010, p.514) argues that “beliefs influence people’s knowledge acquisition and interpretation, their task selection and organization, and their ways of understanding”. He added that these beliefs work as an organiser of the information and significantly contribute to the priorities of categorisation among teachers (Mansour, 2008 cited in Mansour, 2010). Thus, beliefs can be argued as an important factor that influences, and is influenced by, the pre-service teachers’ practice regarding technology adoption. This sheds light on the importance of these beliefs’ development settings and strategies that need to be highlighted by the teacher education programme designer in order to enable pre-service teachers to develop the ‘right’ beliefs about technology’s role. Therefore, when studying the pre-service teachers use of ICT in education, their beliefs about ICT and the factors that influence the development of these beliefs must be considered carefully in addition to other factors in the learning environment that influence their adoption of technology.

Studying science and mathematics pre-service teachers’ beliefs about the use of ICT in educational practice is not an easy task as their belief shapes, and is shaped by, the environment around them and its components. For example, they hold beliefs about the suitability of some kinds of technology with their lesson objectives, the expectations of people around them regarding the use of technology, and their beliefs about their own abilities in using technology properly and the availability of required technology and its resources. These are the three main themes that are in the central focus of Ajzen’s (1991) Theory of Planned Behaviour which was designed to “predict and explain human behavior in specific context" (Ajzen, 1991, p.181). By dividing the focus into the three areas mentioned earlier, Ajzen pays more attention to some social factors that need to be considered if the human behaviour is to be better understood rather than concentrating on internal factors of human thinking. The Theory of Planned Behaviour and its use as part of the theoretical framework of the current study are presented later in this chapter.

From the above discussion, it can be argued that it is important to have positive beliefs about the role of ICT in education for the pre-service teachers to integrate ICT into their classroom activities. However, these positive beliefs are not enough for successful integration of ICT. In addition to the positive beliefs, there seem to be other factors that are reported in the literature that shape and influence the adoption of ICT in the classroom activities among the science and mathematics pre-service teachers.

3.5 Exploring the gap

From the literature review associated with the adoption of ICT among science and mathematics pre-service teachers, it is argued that most of existing studies focus on specific aspects related to the adoption of ICT by 'in-service' teachers. For example, research studying pedagogy related to ICT use found that pedagogical aspects are important and need to be developed if the integration of ICT is to be successful (Jung, 2005; Pineida, 2011; Webb and Cox, 2004). Other research concerned with teachers' beliefs and attitudes towards the use of ICT in education found that teachers' beliefs are important for their adoption of ICT in the classroom. However, their beliefs seem to be influenced by many factors in the learning environment (Blackwell et al., 2014; Jiomyiannis & Komis, 2007; Kalogiannakis, 2010; Lemon & Garvis, 2016; Sime & Priestley, 2005). In addition, some research focused on professional development projects and their role in improving the use of ICT and found that teachers use ICT properly when provided with skills and resources (Lavonen et al., 2006; Postholm, 2007).

Fewer researchers have studied the use of ICT in education by pre-service teachers, who are influenced by many factors that influence teachers' perceptions and practices related to the use of ICT in the classroom, such as beliefs, prior experience of ICT use, availability of resources and equipment (Kaasila & Lauriala, 2012; Tezci, 2011). However, from the literature review, there seem to be many factors that impact on the pre-service teachers' use in particular as they are engaged in a partnership environment between two institutions (university and school), each one has its own objectives and policies. Most research which studied the pre-service teachers' use of ICT, as far as I am aware, focused on particular aspects related to their integration of technology. For example, some research (Sadafet et al., 2012) investigated the pre-service teachers' beliefs about specific applications of technology in teaching and learning (Web 2.0) and did not consider the partnership community that the pre-service teachers are engaged in and its influence on their adoption of ICT. The wider context is also an important element that contributes to shaping the use of technology by pre-service teachers and their perceptions about it. All aspects within a teaching and learning context must be given sufficient attention when studying this issue in order to gain deeper understanding about how their perceptions and practices are shaped. Another study in Turkey (Tezci, 2011) studied the use of ICT by pre-service teachers and focused on internal factors (such as beliefs and experience) and external factors (such as the school support) but with no consideration of the complex partnership setting and the social relationships and their effects. Notably, most of research, which studied the use of technology by pre-service teachers, investigated the issue by focusing on very limited aspects within the context, missing considerable elements in the environment that have direct relationships with the use of ICT by the pre-service teachers.

It can be argued that the complexity of the partnership environment between university and school and its influence on the pre-service teachers' perceptions and practices related to the use of technology make it difficult to have a clear view about how their use of ICT in the classroom is influenced if the whole context is not taken into account. Therefore, ICT should be seen as a part of the learning environment and the community of the partnership between university and school, and the area of focus should include all the components of these interacting systems where individuals interact with others in a setting that consists of individuals, community surrounding them, culture, traditions, and psychological and physical tools used to achieve intended outcomes according to the policies organising the activities (Engeström, 2009).

In short, there seems to be lack of clarity in how perceptions and practices related to the use of ICT by science and mathematics pre-service teachers are influenced and shaped and about the factors that influence their adoption of technology within the complex environment of the partnership setting. This issue needs to be investigated particularly in Saudi Arabia where, as I am aware, there is a lack of research about the use of ICT by pre-service teachers, which considers social and cultural aspects. Moreover, from my experience as a lecturer in the College of Education at the University of Hail in Saudi Arabia and as a tutor of pre-service teachers during their teaching experience for four years, I am aware that investigating this issue within this context is sorely needed due to the regrettable lack of use of ICT by pre-service teachers. There is also a lack of clarity of the factors that shape their use of technology and their beliefs about it, such as university input, pre-service training support and the wider context.

The main purpose of the current study is to investigate Saudi Arabian mathematics and science pre-service teachers' perceptions and practices of the integration of ICT in the classroom and how their use is shaped within the study context. In order to gain deeper understanding about the issue under investigation in all its pedagogical, cultural and social aspects, sociocultural theory is adopted as the theoretical framework of the study. I believe that sociocultural theory allows for looking at the issue from multiple levels which can significantly contribute to existing knowledge about the integration of ICT into classroom activities among science and mathematics pre-service teachers and, consequently would inform pre-service teachers, policy makers, teacher education programme designers and all those who are involved in the pre-service teachers' practice partnership. Within sociocultural theory, multiple frameworks (TPACK, the Theory of Planned Behaviour, affordance theory, identity and agency) are integrated to organise the focus of the study and to highlight many aspects within the context that are related to the use of technology, such as the pre-service teachers' different forms of knowledge, the behavioural, normative, and control beliefs about the use of ICT in education, their identity and understanding of agency, and how these aspects are formed and influenced in the light of the principles of sociocultural theory. I believe that this integration of multiple frameworks will significantly contribute to existing knowledge of the science and mathematics pre-service teachers' use of ICT in educational practice. However, it is worth mentioning that the Theory of Planned Behaviour is not a leading theory in this study, rather, its ideas will be considered at certain stages of the study in order to organise the focus on the pre-service teachers' beliefs and to give insights into the different forms of belief and how they are shaped in the light of the sociocultural context. The TPACK framework is also used as a first phase of the study to provide insights into the pre-service teachers' knowledge and how they perceive that TPACK knowledge before I move to the main phase of the study according to sociocultural theory. I believe that using these multiple frameworks as assistant frameworks to inform the focus of the study according the sociocultural lens is valuable and will provide better and deeper understanding about the issue under investigation. Sociocultural theory is discussed in detail in the next section of this chapter.

3.6 Theoretical framework of the study

In this section of the chapter, I present and discuss the study's theoretical framework which is sociocultural theory and its assistant frameworks.

3.6.1 Sociocultural theory

The nature of human beings is based on practising purposeful activities to achieve specific goals through different kinds of processes depending on the nature of the desired outcomes. An activity can be defined as "a specific form of societal existence of humans consisting of purposeful changing of natural and social reality" (Davydov, 1999, p.39). The persons who participate in an activity, bring with them their own and others' previous experiences, beliefs, and history that effect and shape the process of the activity. Davydov (1999) asserts that the characteristic feature of activity with its purposeful and transforming nature is that it allows the participant to go beyond the limited settings of the activity to take into account the historical and societal dimensions where this activity takes place. This view of human activity is consistent with the constructivist epistemology in which meanings are constructed by subjects (Creswell, 2009). This construction of meaning is influenced by the individual's social and cultural background which steps beyond the limited situation where the meaning construction or 'activity' takes place.

In the last few decades, educational researchers have faced a big challenge when investigating learning situations which always occur within complex environments that shape and are shaped by social, cultural, and historical aspects. Lee (2003, p.393) indicates that "a continuing challenge is how we as educational researchers are to investigate learning and development as these occur in complex settings in an attempt to understand the ecological niches of practice in the real world".

An early attempt to overcome this challenge was Vygotsky's sociocultural theory which was formulated in the light of Marx's psychological ideas as will be discussed later in this chapter. The basic idea of Vygotsky's theory is that the social interaction between an individual and his environment plays a major role in the development of cognition. In other words, the learning process occurs within two levels; firstly, the interaction between the individual and others in his or her environment; secondly, the integration of what has been learned into the mental structure of the individual. Vygotsky (1978, p.57) argued that "every function in the child's cultural development appears twice; first, on the social level, and later, on the individual level; first, between people (interpsychological) and then inside the child (intrapsychological)". A key point in Vygotsky's theory is that the individual's development cannot be understood if it is studied separately from the external social aspects that surround him or her. It is worth mentioning that Vygotsky himself had hardly ever used the term 'sociocultural'. Instead, he and his followers such as Smirnov and Luria usually used the terms ‘sociohistorical’ and ‘cultural-historical’. This change in the heritage terms was a result of the appropriateness of terms in the later debates in the humanities especially in the West. The reason for that “has to do with how culture is understood by the various parties involved” (Wertsch, Rio & Alvarez, 1995, p.6).

When studying human behaviour, looking at the internal factors of the individual is no longer the appropriate way to explain this behavior, according to sociocultural theory, but rather researchers need to consider the external living conditions including traditions, ideas, and other components of the whole context (Daniels, Cole & Wertsch, 2007). The context, according to Veer (2007, p.21) does not include “only physical and socio-economical environment”, but also the intellectual environment such as culture, traditions and ideas.

In this study, the science and mathematics pre-service teachers’ perceptions and practices related to the use of technology is the focus of investigation. Pre-service teachers’ practice seems to be shaped by the particular school context in which they are involved, according to sociocultural theory. However, Vygotsky argued that the practice context is not an absolute entity that has the same influence on every learner (pre-service teacher), but rather depends on the learner himself (Veer, 2007). Any context component might mean different things for different learners, and in turn influence their practice differently. As the pre-service teacher is involved in practice at school, this practice is subject to the context and its social and political influence (Daniels, 2007). Therefore, pre-service teachers’ practical knowledge is shaped by the power of the context’s social circumstances according to Daniels. In the current study, the pre-service teachers’ practical knowledge can be seen as knowledge of practice and knowledge mediated by practice, according to sociocultural thought (Au, 1990). Mediation is a key idea in Vygotsky’s sociocultural theory; this means that human actions are mediated by tools (including cultural, psychological, and physical tools). Wertsch (1990) argues that an essential key to understanding human social and psychological processes is the tools and signs used to mediate them. Mediation and its importance in understanding human activities are explained by Wertsch (1990, p.114) as follows:

> *The fundamental claim here is that human activity (on both the interpsychological and the intrapsychological plane) can be understood only if we take into consideration the "technical tools" and "psychological tools" or "signs" that mediate this activity. These forms of mediation, which are products of the sociocultural milieu in which they exist, are not viewed as simply facilitating activity that would otherwise take place. Instead, they are viewed as fundamentally shaping and defining it.*

Therefore, mediated activities, according to the sociocultural tradition, start as social interactions with others and are then internalized by the learners (pre-service teachers in this case) as their own psychological functions (Kosulin, 2003). This process of development occurs within what Vygotsky called the Zone of Proximal Development. Vygotsky argued that learners (pre-service teachers) could perform actions according to their own capacity only within limits. However, if their performance is guided by others in the social context, they will be able to perform much better. The difference between the levels of the independent performance and guided performance is the Zone of Proximal Development (Hedegaard, 1990). This does not apply only to the child's learning, but also to the pre-service teachers' learning as they acquire knowledge and behaviours from the context where they practice teaching (Whipp, Eckman & Kieboom, 2005).

A crucial element in the pre-service teachers' learning during their teaching practice is assisted or guided performance. While they are in their Zone of Proximal Development they can receive guidance and help from more experienced peers or other teachers at the school to perform teaching tasks. Whipp et al. (2005, p.40) argue that “the help given is not merely directive and evaluative but is designed to scaffold learners through a combination of modelling, feedback, direct instruction, and questioning to a point where they can independently perform the tasks that previously required assistance”. Therefore, for the use of technology with teaching, which is the focus of this study, science and mathematics pre-service teachers need to receive constant guidance from tutors and other teachers at school during their teaching practice in order to develop new ways of using technology within their Zone of Proximal Development (Whipp et al., 2005). Because pre-service teachers move to a new environment when they start teaching practice, they need new psychological tools for these practices (Chaiklin, 2003 cited in Hall, 2007). If they receive the right amount of support from the others at school, then they can acquire these tools from the social interaction in their new environment and they are learning properly within their Zone of Proximal Development (Hall, 2007).

Social interaction does not only mean the indirect information exchange between the pre-service teachers and the others at school, but also the formal assignments and tasks they perform under the supervision of the university tutors and cooperating teachers where they can negotiate and co-construct concepts (Haenen, Schrijnemakers & Stufkens, 2003). The latter (interaction through formal assignments and directive tasks) might be seen as more important for the pre-service teachers’ knowledge construction and development according to Kozulin (2003). He argues that (2003, p.26) “the acquisition of psychological tools must have the character of a deliberate action. If there is no intentionality of the teacher–mediator, psychological tools will not be appropriated by the students or will be perceived as another content item, rather than a tool".

Furthermore, pre-service teachers come to teaching practice with pre-existing beliefs, experiences and concepts about teaching. This highlights the importance of considering the pre-service teachers' identity and their understanding of agency in addition to the contextual factors in the school environment when exploring their perceptions and practices regarding the use of technology in the classroom and the relationships between these two domains. Mansour et al. (2014) argue that teachers' interpretations of the teaching demands and their awareness of the nature of these demands in a given context significantly influence their learning. This sheds light on the importance of the pre-service teachers' identity development during their teaching practice and the influence of the context in shaping their identity. Their pre-existing beliefs seem to play a major role in shaping their educational identity and how they develop it within a given context. Mansour (2010, p.514) argues that "beliefs influence people's knowledge acquisition and interpretation, their task selection and organization, and their ways of understanding". Therefore, the pre-service teachers' beliefs, their identity, and their understanding of agency need to be explored as an important part of the context components in order to provide better understanding about the pre-service teachers' use of technology in the classroom. It is worth mentioning that the use of identity and agency concepts within the sociocultural framework in this study will not focus on the individual level but, rather, I use these domains to better understand the social relationships between individuals within the school context. Identity is used to understand how pre-service teachers develop relationships with the others within the context and agency is used to understand the perceived control the pre-service teachers have over their practice which could shape their social relationships.

3.6.2 Theory of Planned Behaviour

Since the 1990s, the Theory of Planned Behaviour has been widely adopted as a model to study people's beliefs that shape their intentions to perform particular behaviours according to personal and social aspects (e.g. Ajzen, 1991; Armitage & Conner, 2001; Conner & Armitage, 1998; Hagger & Chatzisarantis, 2009; Rivis & Sheeran, 2003). It postulates three aspects that determine people's intentions to engage in specific activity in specific contexts. Firstly, the attitude towards the behaviour, which according to Ajzen (1991, p.188), "refers to the degree to which a person has a favourable or unfavourable evaluation or appraisal of the behaviour in question". The second aspect is the social factor termed 'subjective norm' which "refers to perceived social pressure to perform or not to perform the behaviour" (Ajzen, 1991, p.188). The third aspect is the perceived behavioural control which "refers to the perceived ease or difficulty to performing the behaviour and it is assumed to reflect past experience as well as anticipated impediments and obstacles" (Ajzen, 1991, p.188).

The Theory of Planned Behaviour postulates three types of beliefs (see Figure 3.2 below); behavioural, normative, and control belief, which form the general attitude towards a given situation. Behavioural belief is related to the consequence or the outcome of a given behaviour; normative belief is related to the individual's concern about the expectation of the others in his or her environment about performing a specific behaviour; and control belief is related to the availability of resources and the individual's control over the situation to enact a particular behaviour (Ajzen, 1991).

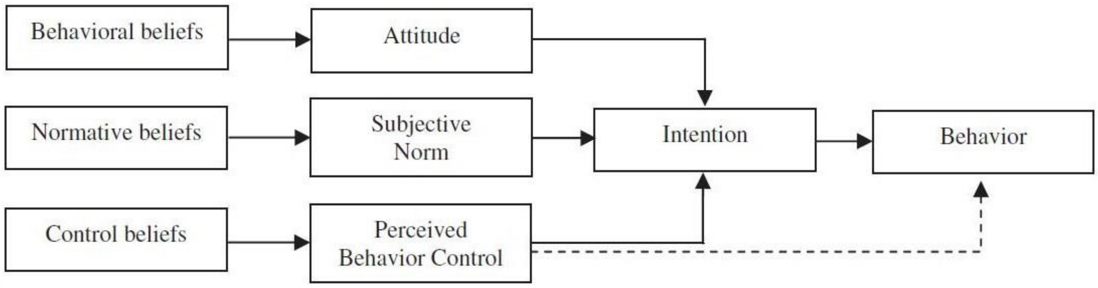


Figure 3.2: Ajzen's Theory of Planned Behaviour (From Sadaf et al.,2012:393)

In order to understand the science and mathematics pre-service teachers' beliefs about ICT use in the classroom, it is important to investigate underlying aspects of each kind of the three beliefs. Sadaf et al. (2012) conducted a study to investigate pre-service teachers' underlying beliefs related to their intentions to use a specific application of ICT, which was Web 2.0 technology. To study this issue, they adopted Ajzen's Theory of Planned Behaviour as a validated theory that provides an in depth description to understand how beliefs influence people's engagement in a given activity (Ajzen, 1991; Sadaf et al., 2012). A brief summary of this study and its findings, using the Theory of Planned Behaviour as a lens to investigate the issue, is presented here as a good example that can inform the current study in the aspect of the science and mathematics pre-service teachers' beliefs about the use of ICT in education. It provides insights into the role of the environment and its social aspects in shaping the pre-service teachers' beliefs about the value of technology in educational practice, which is a key factor that influences their actual use of ICT and is to be focused on within this study. The brief summary is discussed below (Sadaf et al., 2012, p.941-944).

3.6.2.1 Behavioural Beliefs

Behavioural belief refers to the extent to which the pre-service teachers believe that a given behaviour will lead to the intended objective. The study results reveal three main points regarding the pre-service teachers' behavioural beliefs about the use of ICT (Web 2.0 in this case) in the classroom:

1. Value for student engagement and effective learning:

- Sadaf et al. (2012) shows that the pre-service teachers believe that using this technology will improve the pupils' learning so that they are going to use it in their future classrooms. In addition, most of them reported that they will use it to motivate their pupils to learn through a tool that is related to them which can enhance their learning.

2. Easy to use but difficult to integrate within lessons:

- Most of the pre-service teachers indicated that using Web 2.0 is very easy to use and they are very confident in using it. However, they reported that it is challenging to integrate it into their lessons and it is difficult to find the appropriate application that matches the lesson objectives.

3. Varied use according to grade level and content area:

- Interviews with pre-service teachers and their reflective data show that they believe that the usefulness of this technology (Web 2.0) depends on the teaching subject and its content. Also, it depends on the age level of the students. This technology might be suitable for use with older students and might be used with younger students as only a demonstration tool rather than a learning tool.

3.6.2.2 Normative Beliefs

Normative belief refers to the extent to which the pre-service teachers believe that the other people in their context expect them to perform a specific behaviour (Ajzen, 1991). Sadaf et al.'s (2012) survey data show that, among pre-service teachers, the most frequently reported reason for using technology was the pupils' expectation (45%), administrators' expectation (38%), colleagues' suggestions (26%), parents (13%), and even everyone (11%). All the pre-service teachers reported that their pupils would influence their adoption of technology. They believe that this kind of technology is very familiar to the 'digital age' children and they will be very comfortable in using it and motivated to learn through it.

3.6.2.3 Control Beliefs

Control belief refers to the pre-service teachers' belief about the control they have to perform a particular behaviour according to the availability of internal and external factors (Ajzen, 1991). Sadaf et al.'s (2012) survey data shows that almost half of the pre-service teachers involved in their study reported high self-efficacy in personal skills of using Web 2.0 technology. Moreover, about 30% of the pre-service teachers believe that this kind of technology facilitates access to learning anywhere at any time outside the classroom. However, some of them believe that limited access to resources such as computers and the internet for some students would influence their adoption of this technology (Sadaf et al. , 2012, p.941-944).

3.6.3 Identity and agency

Identity is defined as "a constant social negotiation that can never be permanently settled or fixed, occurring as it necessarily does, within the irreconcilable contradictions of situational and historical constraints" (Britzman, 1992 cited in Moore, 2008, p.590). It can change from one context to another and from time to time. Thus, its dynamic nature means that individuals are different in different contexts by developing characteristics related to a given context (Moore, 2008). Identity is developed by the individuals' feelings about themselves, and associated with other professional aspects such as the teaching subject. For example, the pre-service teachers perceived themselves as students, teachers, science teachers or mathematics teachers. This is related to their understanding of their role at school: are they agents of change? Are they 'instruments' of more powerful agents within the context?

Agency is defined by Inden (2000 cited in Moore, 2008, p.591) as

> *The realized capacity of people to act upon their world and not only to know about or give personal or intersubjective significance to it. That capacity is the power of people to act purposively and reflectively, in more or less complex interrelationships with one another, to reiterate and remake the world in which they live, in circumstances where they may consider different courses of action possible and desirable, though not necessarily from the same point of view*

Because of the dual role of individuals in the context (being social producers and social products at the same time), they act as agents of change in the community and sometimes as 'instruments' that perform the other agents actions (Moore, 2008). Therefore, agency can be seen as the extent of the power the science and mathematics pre-service teachers have (or perceive to have), their use of their identity as science or mathematics teachers within the school context to make changes in their practice. According to Nykvist and Mukherjee (2016, p.851), "the notions of identity and teacher education have attracted considerable research over the years, revealing a strong correlation between teacher beliefs and practices and the resultant impact on pedagogical practices in the classroom". One of the crucial questions this study attempts to address is how pre-service teachers' perceived identity and agency shape their social relationships within the school context and how this influences their practice.

Literature has reported findings related to the pre-service teachers' identity and agency as strongly connected domains. It was found that pre-service teachers develop different identities and agencies within the same context (Moore, 2008). For example, some of them held strong agency and strong science teacher identity and saw themselves as 'agents of change' considering the power they had in shaping their pupils' learning. Others did not perceive themselves as agents of change because they did not yet perceive themselves as teachers. This difference in perceived identity and agency among the pre-service teachers might be a consequence of their view about the 'power of change'. For example, those who saw themselves as agents of change might focus on the classroom practice level where they have control over the situation, while those who did not perceive themselves as agents of change might focus on the larger society where they might be 'instruments' of more powerful agents (Moore, 2008). This supports what was argued earlier in this section that context components might mean different things for different individuals. It also sheds light on the importance of exploring the development of identity and agency within the sociocultural framework in order to better understand the Saudi Arabian science and mathematics pre-service teachers' perceptions and practices of the integration of ICT in the primary school classrooms during their teaching practice and the role of the context and social relationships in shaping their identity and practice. Therefore, identity and agency are employed in the current study in addition to TPACK, Theory of Planned Behaviour, and affordance theory within the sociocultural framework as powerful domains that help in understanding the issue under investigation from a sociocultural perspective by answering the following research questions:

- What is the science and mathematics pre-service teachers' perceived technological pedagogical content knowledge (TPACK)?
- What is the relationship between the science and mathematics pre-service teachers' perceptions and practices of the integration of technology in the classroom?
- What is the relationship between the science and mathematics pre-service teachers' experience with technology and their practices of the integration of ICT in the classroom?
- How does the school setting influence the pre-service teachers' perceptions and practices of the integration of technology in the classroom?
- How does the university setting influence the pre-service teachers' perceptions and practices of the integration of technology in the classroom?
- How does the partnership setting influence the pre-service teachers' perceptions and practices of the integration of technology in the classroom?

3.7 Summary of the chapter

In this chapter, I have reviewed the relevant literature, explored the gap that the current study attempts to occupy, and discussed the theoretical framework that drives this study. Throughout the chapter I defined the area of focus, narrowing down the research gap and ending with the research questions that emerged from the gap. At the beginning of the chapter, I started with reviewing literature about ICT in education, ICT definitions, and the benefits of ICT in education. I then moved to the ICT skills and teachers' preparation, reviewing literature that discussed how skills might influence the use of technology. After this general review about teachers' use of technology, I narrowed down the discussion on pre-service teachers' use of technology. More deeply, I then discussed pedagogy and ICT, affordances of technology, pre-service teachers' knowledge related to the use of technology in the classroom, and their beliefs about technology. At the end of this review of the relevant literature, I explored the gap that this study attempts to fill. I concluded the chapter by presenting the theoretical framework of the study and how it allows deeper investigation and contributes in occupying the literature gap. In the following chapter, I present detailed information about the research methodology and design.

4 Research Methodology

4.1 Introduction

This chapter presents a detailed description of the research methodology and design followed to conduct this study. The research objectives and questions are presented at the beginning of this chapter followed by the philosophical assumptions, research paradigm, ontology and epistemology. Then, the methodology of the study is presented including description of the sampling, research methods and instruments. Also, ethical issues and the procedure of data collection are presented followed by the data analysis processes and theoretical considerations related to the analysis. I conclude the chapter by discussing the trustworthiness of the research including credibility, transferability, dependability and confirmability.

The study aims to explore the Saudi Arabian science and mathematics pre-service teachers' perceptions and practices of the integration of technology in the primary school classrooms and identifies the key factors that influence their practice with regard to the use of technology in the classroom. The relationships between their identity development, their understand of agency, and their recognition of technology affordances in the light of the practice sociocultural context are examined in depth to provide insights into the pre-service teachers' practice related to technology and their perceptions about it. To achieve these aims, the study seeks to answer the following research questions:

- What is the science and mathematics pre-service teachers' perceived technological pedagogical content knowledge (TPACK)?
- What is the relationship between the science and mathematics pre-service teachers' perceptions and practices of the integration of technology in the classroom?

- What is the relationship between the science and mathematics pre-service teachers' experience with technology and their practices of the integration of ICT in the classroom?
- How does the school setting influence the pre-service teachers' perceptions and practices of the integration of technology in the classroom?
- How does the university setting influence the pre-service teachers' perceptions and practices of the integration of technology in the classroom?
- How does the partnership setting influence the pre-service teachers' perceptions and practices of the integration of technology in the classroom?

4.2 Research paradigm

A common issue that characterises educational research is the variety of research approaches that can be adopted. Various frameworks can be used to answer different kinds of questions (Pring, 2000). Educational research can be conducted from different philosophical perspectives and with a variety of methods, depending on the nature of the knowledge that researchers attempt to discover. According to Pring (2000), the variety in educational research is a characteristic feature of it. Different approaches require different kinds of research and thus reach different findings. Adoption of a specific approach depends upon ontological, epistemological and methodological questions (Guba, 1990).

Comparing the two main philosophical stances, the scientific or positivist philosophical stance is appropriate for the physical world and works by collecting numerical data by applying quantitative methods such as closed-ended questionnaires. In contrast, the interpretivist stance is more appropriate to studying social and personal realities which provide in-depth description by collecting qualitative data and constructing meanings by the interpretations of subjects (Pring, 2000). As this study explores the pre-service teachers' perceptions and practices in the light of a sociocultural context and circumstances, it adopts the interpretivist paradigm. MacNaughton (2001, cited in Alzaydi, 2010, p.103) argues that "interpretivism seeks to explain how people make sense of their circumstances, that is, of the social world". Since this study considers the pre-service teachers' perceptions of the use of technology in the classroom, and explores the influences of context and social interactions on the adoption of technology in their practice, I believe that the research should be informed by the interpretivist view.

4.2.1 Ontology

Ontology is defined as the study of being; it emphasises the question: "what is the nature of existence?" (Crotty, 1998, p.10). According to Guba (1990), the ontological question asks about the nature of reality. Different ontological stances can be adopted depending upon the reality that researchers aim to discover. The nature of reality in the philosophical assumptions of educational research can be seen through at least two ontological views: the first is 'realism' that is defined by Pring (2000) as "the view that there is a reality, a world, which exists independently of the researcher and which is to be discovered". The second is 'relativism', which holds the view that there is no absolute truth but there are relative subjective values. By taking the differences in the participants' perspectives and their explanations of the issue into account, I believe that the ontological stance of the current study is relativism.

The multiple perspectives about the factors that influence the pre-service teachers' perceptions and practices related to the use of technology in the classroom exists independently of the researcher, is constructed by the participants according to different sociocultural variables and positions, and needs to be explored. In addition, the issue of ICT integration in the classroom is explored from multiple perspectives including pre-service teachers (science and mathematics), university tutors and head teachers.

4.2.2 Epistemology

Epistemology deals with the nature of knowledge (Crotty, 1998, p.8). It is defined by Wellington (2000, p.196) as “the study of the nature and validity of human knowledge”. The epistemological question asks about the nature of the relationship between the knower and the knowable or what can be known. While the scientific paradigm often seeks to discover the objective reality that exists ‘out there’ in the world, the social constructionist view is that “meanings are constructed by human beings as they engage with the world they are interpreting” (Creswell, 2009). According to Crotty (1998), constructionist epistemology holds the view that there is no objective truth waiting to be discovered. He adds “meaning is not discovered but constructed”. Due to the nature of knowledge that the current study seeks to explore, which is constructed by different participants who may construct meanings from different perspectives, the epistemological stance that is held in this research is a constructionist one. In other words, every participant could indicate different factors that could influence and shape the use of technology in educational practice. Moreover, I attempt to construct meaning from the participants’ interpretations of the factors that influence the pre-service teachers’ use of technology in the classroom. The study recognises that each participant has a unique background and experience about technology that has been constructed over the years. Therefore, the study explores the integration of ICT in science and mathematics lessons from this perspective of constructivism.

4.3 Methodology

Methodology is defined as "the activity or business of choosing, reflecting upon, evaluating and justifying the methods you use" (Wellington, 2000, p.22). It is also defined by Crotty (1998, p.7) as "the research design that shapes our choice of the methods". The latter can be defined as the actual techniques and processes employed by researchers to obtain the knowledge.

Methodologically, researchers can adopt three types of design to conduct their research depending upon the intended knowledge or nature of the findings: quantitative, qualitative and mixed methods. An example of quantitative strategies is survey research that provides numerical descriptions of attitudes or trends of a sample population through the use of questionnaires or structured interviews with the intent of generalisation (Babbie, 1990, cited in Creswell, 2009). In contrast, qualitative research can be conducted by, for instance, using a case study strategy which aims to explore a process or value of activity in depth by observation or open-ended interviews.

Because of the exploratory nature of this study, which explores the Saudi Arabian science and mathematics pre-service teachers' perceptions and practices of the integration of technology in the classroom, case study – as a qualitative strategy - is adopted as its methodology. I believe that the qualitative strategy of the current study enables me to explore the complexity of the sociocultural context and its relationships. I also argue that the qualitative approach allows me to study the issue in depth because of its many advantages over other strategies. Gillham (2000, p.11) summarised what a qualitative strategy enables researchers to do, as follows:

- To carry out study where the other strategies are not appropriate and cannot answer the research question. In the current study, only qualitative strategies can provide understanding of the complexity of the issue taking the context into account.
- To explore situations where little is known about the issue under investigation. As mentioned earlier, there is a lake of clarity surrounding the issue under investigation in the intended context which makes the qualitative strategy the most appropriate strategy to conduct this research.
- To investigate complexity which is beyond the scope of the controlled research setting. In this study, relationships between many aspects that influence the pre-service teachers' use of ICT in the classroom is investigated in depth. In this case, the qualitative strategy enables me to go beyond any limited research scope to wider view of the issue.
- To study what is 'under the skin' of an organization or group to find out what is really going on regarding the issue under investigation by looking from the inside to understand the informal reality. This advantage of qualitative strategies can clearly support my choice of case study as a methodology of studying this issue.
- To look at the situation from the perspectives of those involved in the issue under study.
- To conduct research into the processes which lead to results rather than into the importance of the results themselves.

Robson (2002) defines case study as "A well-established research strategy where the focus is on a case (which is interpreted very widely to include the study of an individual person, a group, a setting, an organisation, etc.) in its own right, and taking its context into account" (p.178). He adds that case study involves several methods of data collection which can include quantitative and qualitative data. Case study is also defined by Wellington (2000, p.90) as "a detailed examination of one setting, or one single subject, or one single depository of documents, or one particular event".

I believe that case study has several advantages over other methodologies for this study, as Cohen et al. (2000) indicate, because case study data is strong in reality. Because of its attention to real social situations, case study recognises complexity and the relationships between actors and their environment in the specific society. In the current study, this provides better understanding regarding the many factors that could influence the use of technology in the classroom by the pre-service teachers, such as the university courses, educational policy, school environment, available resources and personal perceptions of the pre-service teachers about the value and effectiveness of technology in education. This focus is also consistent with the theoretical framework of the study, namely sociocultural theory. In addition, Nisbet and Watt (1984, cited in Cohen et al., 2000) highlight many advantages of case study over other methodologies. They indicate that the results of case study can be easily understood by a wide range of audiences including non-academics. They add that case study is strong in reality, can provide insights into similar situations and can be conducted by a single researcher without the need of a research team. Furthermore, I choose case study to investigate this issue because case study, as Wellington (2000) highlighted, involves studying many aspects within the context under investigation, such as resources including equipment, documents, working management and other aspects which can improve the process of the current study and provide better understanding of the issue.

Stake (2000, p.437) identifies three types of case study. These types can be summarised as follows:

- The ‘intrinsic’ case study which is undertaken to provide better understanding of a particular case regardless of the presentation of other cases. This case is interesting in itself within its particularity and ordinariness.
- The ‘instrumental’ case study in which a particular case is studied mainly to provide insights into the wider context of the issue or to support a generalisation. The examined case in this type plays a supportive role and it is of secondary interest itself and the main purpose is to provide better understanding of something else.
- The ‘collective’ case study where a number of cases are examined in order to investigate a phenomenon or a general condition.

I argue that the case study type in the current study has features of the first and the second types simultaneously. Firstly it will be an intrinsic case study in which the science and mathematics pre-service teachers’ perceptions and practices of the integration of technology in the classroom at the University of Hail is particularly studied in depth because of the lack of studies that cover this area in the intended context which could lead to many new insights. Secondly, it will also be an instrumental case study that provides insights into the factors that influence and shape the use of technology in the classroom in the whole country of Saudi Arabia and the wider Arab world due to the similarities between educational policies and systems, teacher education systems and cultural backgrounds. In addition, the case study findings may support the findings of studies that have been carried out in developed countries, as discussed earlier in the literature review chapter, which can support generalisation to contexts around the world.

4.3.1 Sampling

Sampling was given due consideration in light of the importance of sample size and sampling strategy in research quality. Cohen et al. (2000) assert that “the quality of a piece of research not only stands or falls by the appropriateness of methodology and instrumentation but also by the suitability of the sampling strategy that has been adopted” (p.92). There are many factors that determine the sample size, such as accessibility and time. Moreover, the research style plays a major role in the decision of sample size. For example quantitative research, such as survey research, usually requires a larger number of participants if numerical data are to be calculated statistically, while qualitative research is more likely to use a smaller sample size. In addition, expense, available support, resources and the number of researchers need to be taken into consideration when deciding the sample size (Cohen et al., 2000).

Regarding the sampling strategy, depending upon the sample needed and the size of the population, researchers need to choose an appropriate and justified strategy of sampling. This could be either ‘probability’ also called ‘random’ sampling, or ‘non-probability’ also called ‘purposive’ sampling, considering the extent to which it represents the whole population (Cohen et al., 2000). Unlike quantitative research, which requires large representative and random samples from which to generalise results to the wider population, qualitative research usually chooses smaller samples to understand a phenomenon through deep investigation in a specific context (Cohen et al., 2000; Hoepfl, 1997; Richie and Lewis, 2003). Cohen et al. (2000, p.93) confirm that the sample size is “determined to some extent by the style of the research. For example, a survey style usually requires a large sample, particularly if inferential statistics are to be calculated. In an ethnographic or qualitative style of research it is more likely that the sample size will be small". For the current study, which is a case study, a non-probability sampling strategy was followed to choose the participants. This was because the small group of science and mathematics pre-service teachers was the focus of the researcher's interest. Cohen et al. (2000, p.102) argue that "this is frequently the case in small scale research, for example, as with one or two schools, two or three groups of students, or a particular group of teachers, where no attempt to generalize is desired; this is frequently the case for some ethnographic research, action research or case study research".

4.3.1.1 Questionnaire sample

As a first phase of the study, the questionnaire was given to the whole population of science and mathematics pre-service teachers (28 science pre-service teachers and 25 mathematics pre-service teachers). As a quantitative instrument, I chose the total population sampling strategy (convenience strategy). This sampling strategy allows the researcher to simply choose the participants from those to whom the research has access (Cohen et al., 2000). They argue that convenience sampling "involves choosing the nearest individuals to serve as respondents and continuing that process until the required sample size has been obtained" (p.102). This was performed to obtain as much background information from the participants as possible before moving to the main, qualitative, phase of the study with its classroom observation and interviews. This issue is explained in greater detail later in the research methods and instrument section. I chose science and mathematics pre-service teachers particularly as the sample of the study because, as discussed earlier in the literature review chapter, teachers of these subjects seem to use technology in their teaching more than others. By choosing the sample from science and mathematics pre-service teachers, I ensure a higher level of technology use among the sample which should allow accurate investigation of the issue. In addition, these two subjects are my area of interest and specialism in the field of education.

4.3.1.2 Observation and interview sample

In the second phase, and for the classroom observation, purposive sampling was used to select the available pre-service teachers (three science and two mathematics) from those who had completed the questionnaires and indicated that they used technology in the classroom in their teaching and agreed to participate in the study. In addition, two pre-service teachers (one science and one mathematics) were chosen purposively from those who indicated that they did not use technology in their teaching in order to investigate their views and allow the comparison at a later stage. I chose these two pre-service teachers particularly from the same schools of those who used technology in their teaching which would allow comparison in the same context. In the third phase, the pre-service teachers who had already been observed were interviewed to study their perceptions and practices related to technology in depth. In addition, interviews also included four university tutors, and four head teachers who were chosen purposively from the schools where the interviewed pre-service teachers were placed. The number of interviewees was: seven pre-service teachers, four university tutors, and four head teachers (15 participants in total).

4.3.2 Research methods and instruments

In light of the methodological approach adopted in this study, namely a case study, mixed-methods of data collection are employed to obtain quantitative and qualitative data. Robson (2002, p.178) argues that one feature of case study research is that it can involve more than one method of data collection, obtaining both quantitative and qualitative data. The methods of data collection in this study are questionnaire, classroom observation and interview. I believe that these methods of data collection are relevant to the research questions and the theoretical framework of the study, sociocultural theory, because they can provide comprehensive information about the impact of many aspects within the university and school settings and the interaction between them on the pre-service teachers' adoption of technology in the classroom. Table 4.1 shows a summary of the research methods, research questions that they seek to answer, and the participants in each method:

Table 4.1: Research instruments, research questions and participants

Instruments	Research questions	Participants
Questionnaire	What is the science and mathematics pre-service teachers' perceived technological pedagogical content knowledge (TPACK)?	28 science student teachers 25 mathematics student teachers
Observation and Interview	What is the relationship between the science and mathematics pre-service teachers' perceptions and practices of the integration of technology in the classroom? What is the relationship between the science and mathematics pre-service teachers' experience with technology and their practices of the integration of ICT in the classroom? How does the school setting influence the pre-service teachers' use of technology in the classroom? How does the university setting influence the pre-service teachers' use of technology in the classroom? How does the partnership setting influence the pre-service teachers' use of technology in the classroom?	4 science student teachers 3 mathematics student teachers 4 university tutors 4 head teachers

4.3.2.1 Questionnaire

The questionnaire is one of the data collection methods in this study because such an instrument can be used as a part of case study research methods to obtain quantitative data (Yin, 2009). It is often argued that such a survey is informed by the scientific point of view. However, Wellington (2000) asserts that some kinds of data that is collected by questionnaires can be qualitative in nature. He adds (ibid) that this kind of data can help in developing theory in the same way as interview and observation data.

For the purpose of this study, the TPACK questionnaire is adopted as a validated instrument for measuring the pre-service teachers’ technological pedagogical content knowledge. It has been modified from the original TPACK questionnaire by experts in the field to measure pre-service teachers' knowledge of teaching and technology (Koehler, 2011).

I argue that collecting questionnaire data as the first phase of the study provided me with a wide picture and overview of an important aspect of the issue under investigation, namely the pre-service teachers’ perceived knowledge of technology use in education. This provided useful background and insight into what is explored in more depth in the main, observation and interview, phases of data collection. I also argue that the questionnaires could provide this insight because they were completed by a larger sample of pre-service teachers with different teaching subjects (mathematics and science). The questionnaires should reveal various factors that influence their use of technology in educational practice in relation to their perceived knowledge, and reveal a wider range of possible elements that influence their adoption of technology.

Furthermore, while this study is mainly qualitative in nature, the TPACK closed-ended questionnaire was used to provide quantitative background information about the pre-service teachers’ technological pedagogical content knowledge. This is useful for understanding the whole picture of the pre-service teachers’ use of technology and how their perceived knowledge might affect their perceptions and practices related to technology, and be viewed in relation to the analysis of qualitative data from the interviews and classroom observation. It is worth mentioning here that the TPACK questionnaire does not test the participants' knowledge but, rather, it explores their own perceptions about their knowledge by asking them how they perceive their level of knowledge in each construct of TPACK.

The questionnaire aimed to answer the research question: 'What is the science and mathematics pre-service teachers' perceived technological pedagogical content knowledge (TPACK)?' This might partly explain the level of their use of technology and the relationships between their perceptions and practices related to technology, which is explored in depth through the classroom observation and interviews. The questionnaire aims to provide a quantitative description about the pre-service teachers' perceived knowledge.

In the TPACK questionnaire, closed questions were asked because they are easier and quicker for participants to answer, which encourages a higher completion rate. Moreover, this kind of question enables me to cover more areas around the issue in the given time (Oppenheim, 1992). Oppenheim (ibid) adds that closed questions have many advantages such as: saving time, no extended writing, low costs, easy to process, and allowing for the group comparisons needed in this study to compare the pre-service teachers' knowledge by variables such as their teaching subject. On the other hand, closed questions do not allow the participants to add their own comments or give more explanation (Cohen et al., 2000). However, the interviews enabled the participants to provide more explanation and express their own views. I believe that using the closed-ended questionnaire followed by in-depth interview can help me to overcome the limitations and disadvantages of each.

In this study, I adopted the TPACK questionnaire as a validated instrument (Koehler, 2011), as will be explained later in this chapter, with slight changes in the items' number and wording to make it suitable for the current study. Then this study's English version of the questionnaire (see Appendix 1) was sent to four experts in the field including my supervisors to ensure its validity and appropriateness for the current study. According to the feedback they provided about the design of the questionnaire, the final version (see Appendix 2) consisted of several sections. Firstly, as Wellington (2000) recommended, there was a brief letter to explain the aims of the questionnaire and to emphasize the guarantee of confidentiality and anonymity of the participants' data. The second section addressed the participants' demographic information, followed by the multiple choice items. Following Koehler (2011), the questionnaire items were divided into several sub-sections informed by the TPACK division of knowledge. The questionnaire consisted of seven subsets of knowledge: Technological Knowledge (TK) seven items, Content Knowledge (CK) three items, Pedagogical Knowledge (PK) seven items, Pedagogical Content Knowledge (PCK) two items, Technological Content Knowledge (TCK) three items, Technological Pedagogical Knowledge (TPK) seven items, and Technological Pedagogical Content Knowledge (TPACK) four items. Following Koehler (2011) and Koh et al. (2013), it was intended to make each subset of items into a scale of measurement. After having the final version of the questionnaire ready, two versions were produced according to the teaching subjects (science and mathematics). This including changes in the wording of items contained the teaching subject only to make the questionnaire more specialized for the participants' teaching subject. As the participants' first language was Arabic, I translated both versions from English to Arabic (See Appendix 3 for the Arabic science questionnaire and Appendix 4 for the Arabic mathematics questionnaire) with the help of an expert in English whose first language is Arabic (a lecturer in the English language department in the College of Art at the University of Hail). The expert reviewed my own translation and provided me with comments that improved the quality of the translation. Further processes were carried out as a part of the questionnaire design after conducting the pilot study. This issue is presented in greater detail later in this chapter in the procedure of data collection section.

4.3.2.2 Observation

Observation is used as an instrument for gathering live data from a situation (Cohen et al., 2000). It provides researchers with the opportunity to study particular aspects taking the context and its social assumptions into consideration. Cohen et al. (2000, p.305) argue that observation allows researchers to “see things that might otherwise be unconsciously missed, to discover things that participants might not freely talk about in interview situation, to move beyond perception-based data (e.g. opinions in interviews), and to access personal knowledge”. Through observation, researchers can gather either quantitative data, by counting events according to a checklist, or qualitative data by taking notes (Wragg, 2002). More specifically, three types of observation are defined; structured observation that has its categories and areas of focus worked out in advance, semi-structured observation that has its agenda of issues but gathers data in a less systematic way, and unstructured observation that is unclear about what is looked for (Cohen et al., 2000).

In the current study, semi-structured observation was conducted to explore the use of technology by science and mathematics pre-service teachers in the real setting of the classroom before conducting interviews with the participants. I employed semi-structured observation as it draws attention to aspects of technology use during lessons in a fairly unsystematic manner. This could keep the focus on the pre-service teachers' use of technology with flexibility to explore the issues and new themes that could emerge during the observation. I believe that conducting observations before interviewing the participants could provide valuable insights into what should be focused on during the interviews and that it should inform the interpretation of the interview data. Wragg (2002, p.11) argues that "by observing the events and interviewing the participants the observer was able to fill out an interpretation of what was happening in the classroom that would not have been apparent from even counting alone".

As explained earlier in the participants' section, seven pre-service teachers were observed when teaching in the classroom as follows: three science pre-service teachers who use technology, two mathematics pre-service teachers who use technology (three lesson for each participant), one science and one mathematics pre-service teacher who do not use technology in their teaching (two sessions for each participant). I argue that this variety allows for comparison between the sub-groups and therefore provides better understanding of the issue under study.

An observation form (instrument) was designed according to the purpose of this study (see Appendix 5) consisting of eight sections. The first section asks for information on the participant and the lesson, including school name, participant name, subject, date, time, class, location, and the topic of the lesson. The second is for notes about the room description. The third is the students' working groups and division. The fourth section in the observation instrument covers the role of the pre-service teacher in the lesson. The fifth section concerns the technology equipment that was used in the lesson, while the sixth section is about the way the pre-service teacher uses technology during the lesson. The seventh section is about the importance of technology for the lesson, and the final section tries to capture the student teacher's knowledge of using technology in the light of TPACK principles. To ensure the validity of the instrument, it was sent to five experts in the field, including my supervisors, who all agreed that the instrument was appropriate for the purpose of the study. As the participants' first language is Arabic, the observation form was translated from English to Arabic (see Appendix 6) with the help of an expert in English whose first language is Arabic. This step was necessary in order to show the participants the form after the observation sessions in order to approve it and give any further comments. Furthermore, a pre-observation form was designed (see Appendix 7), translated to Arabic as their first language (see Appendix 8), and then given to the participants prior to each observation in order for them to provide information about the lesson before conducting the observation, such as lesson description, technologies that will be used, how the participants are going to use them, and any other information that the participant would mention. In order to improve the validity of the instrument, it was reviewed by several experts in the field, including my research supervisors and some colleagues in the school.

The classroom observations were video-recorded after obtaining relevant permission from the participants, as video-recording offers many advantages for the observer. Wragg (2002) argues that video-recording allows researchers to replay the lesson several times without the pressure of making instant notes. In addition, lessons can be replayed and discussed later with the participants. However, it is worth mentioning that the purpose of video-recording was to replay the lesson recording when needed and to review the notes taken during the lessons. This allowed me to ensure the quality of my notes and provided me with the opportunity to write more notes and engage more with the lessons' context.

4.3.2.3 Interview

Cannell and Kahn (1968, cited in Cohen et al., 2000, p.269) defined the research interview as "a two-person conversation initiated by the interviewer for the specific purpose of obtaining research-relevant information, and focused by him [sic] on content specified by research objectives of systematic description, prediction, or explanation". The interview is the main source of data in the current study because such a method is seen as an important and essential source of case study data that deals with human behaviour and activities. Through interviews, participants can provide valuable information and insights into the subjective aspects of their perceptions, practices and activities related to the use of technology and the factors that influence these aspects, which is the main focus in the current study (Yin, 2009).

I argue that the interview, as one of the most common methods of data collection in case study research, would provide me with the data needed to answer the research questions, more so than any other method, due to the nature of the required data which is related to the participants' perceptions and practices related to the adoption of technology and the influence of the university and school settings' components on their adoption. In this regard, the interview provided both the interviewer and interviewee with the perfect opportunity to discuss in greater depth, and in live interaction, the situations in which they were involved. The interviews also enabled the participants to express how they saw the situation from their personal perspectives (Cohen et al., 2000). Cohen and colleagues (ibid, p.267) add that "in this senses the interview is not simply concerned with collecting data about life: it is part of life itself, its human embeddedness is inescapable".

Furthermore, and taking the aim of exploring new or unexpected factors into account, I believe that interviews enabled me to probe for more information about any specific answers or themes that were raised by the participants during the interviews and to explore them in more detail. Oyaid (2009) argues that the interview has many advantages over other methods when dealing with human affairs. For example, such a method enables the participants to express what is meaningful for them without being limited by specific categories or closed questions. Moreover, the interview can provide the researcher with the opportunity to be more flexible and to clarify any participants' misunderstanding that could occur during the interview. In addition, the interview can be seen as one of the most suitable methods of data collection when exploring complex issues like the issue under investigation that has many complex relationships within the teaching practice sociocultural context in both the university and the school settings and the interaction between these two settings. In other words, studying the science and mathematics pre-service teachers' perceptions and practices of the integration of technology in the classroom in the light of many elements such as policy, environment, community and their personal views, I argue that using interviews could provide me with the flexibility to go further and follow any interesting answers or new themes.

Cohen et al. (2000) assert that a common use of the interview is to be in conjunction with other research methods in the same research to validate the results of other methods and to follow interesting and unexpected results by studying in depth the reasons behind the participants' responses and the motivations that make them act in specific ways. In this study, the interview is used in conjunction with questionnaire and classroom observation. Through the interview I attempt to go beyond the questionnaire results and what is observed in the classroom by studying the aspects that were raised from their findings in depth.

Although the interview can provide researchers with many advantages, as discussed earlier, it has some limitations that need to be taken into consideration to make it serve the aims of the study. For example, Cohen et al. (2000) mention that the interview is less reliable than the questionnaire because it offers the participants less anonymity. It can also be negatively influenced by the participants' moods and circumstances during the interview time. In addition, it can be time consuming regarding the analysis and interpretation of its data (Oyaid, 2009). With regard to these issues, I took them into account when collecting data by explaining the aims of the interview to the participants and assuring their anonymity and confidentiality. Moreover, this study is conducted over several years which can offer sufficient time for the data collection, analysis and interpretation.

There are three types of interview that differ in the degree of their structure. Wellington (2000) makes distinctions between these three types as follows:

- Structured interview, where there is a set list of questions with fixed wording which is similar to the questionnaire except that it allows the interviewee to give open responses.
- Unstructured interview, in which the interviewer has an open area of interest without any list of questions or order. In this type, as Alzaydi (2010) indicates, the conversation can go in any direction and it builds itself.

- Semi-structured interview, where a compromise between structured and unstructured types can be reached. This compromise enables the researcher to avoid the limitations of the structured interview and the problems of the unstructured one.

Semi-structured interviews were designed for the purpose of this study based on the review of related literature, validated by experts in the field including my supervisors, academics, and PhD students. Four versions of the interview questions were produced for the four groups of participants: pre-service teachers who use technology (see Appendix 9), pre-service teachers who do not use technology (see Appendix 10), university tutors (see Appendix 11), and head teachers (see Appendix 12). As the participants' first language was Arabic, the four versions of the interview questions were translated from English to Arabic (see Appendix 13 for pre-service teachers users of technology interview, Appendix 14 for pre-service teachers non-users of technology interview, Appendix 15 for university tutors' interview and Appendix 16 for head teachers' interview) by the researcher. The translation quality was checked by an expert in English language (a lecturer in the English language department in the College of Art at the University of Hail) whose first language is Arabic. I argue that this type of interview, using open questions, provided me with the flexibility to ask more questions about interesting points that were raised by the participants and it allowed the participants to give more information from their points of view within the direction that served the research questions (Kvale and Brinkmann, 2009). This 'controlled flexibility' enabled me to cover all the key elements in the light of sociocultural theory, the elements that emerged from the findings of the questionnaire and classroom observations, and the research questions.

4.3.3 Ethical issues

Ethics are significant concerns that have to be considered carefully by researchers when conducting research in general, and become even more significant in educational research that deals with humans. According to Pring (2000, p.142), “the ‘search for rules’ is at least one important ethical dimension to any consideration of human behaviour”. Moreover, ethical concerns should be the priority of researchers during their research and should continue through all the research stages (Wellington, 2000). In the last few years, many attempts have been made to create lists of principles that can guide researchers in avoiding problems associated with ethics when conducting their research. One comprehensive and useful source is the British Education Research Association (BERA) ethical guidelines for educational research, which were released in 2004. However, one set of principles might be not sufficient to discuss and cover every single factor that could influence the research ethically. In this matter, Pring (2000, p.142) argues that “moral judgements or decisions require a great deal of deliberation on the light of many factors which have to be taken into account”.

Ethical issues were considered carefully and taken into account through all the research stages starting from the basic principles such as the anonymity and confidentiality of participants, their right to withdraw at any stage of the research, their voluntary informed consent and the other principles in the British Education Research Association’s ethical guidelines (BERA, 2004). In addition, the ethical requirement of the University of Exeter was considered carefully when conducting the study and the Certificate of Ethical Approval was sought from the University of Exeter’s Ethics Committee (see Appendix 17). Also, an approval from the local educational authority in Hail in Saudi Arabia (see

Appendix 18) was sought to access to school in order to conduct classroom observation and interview the participants and to access the school sources. Moreover, permission was gained from the University of Hail (see Appendix 19) to conduct the study and to access the university sources. Furthermore, classroom observations were video-recorded and the interviews were audio-recorded which needs to be ethically considered. This was made clear on the consent forms (see Appendix 20) that were signed by all the participants agreeing to this procedure after they read the information letter sent to them prior to their participation (see Appendix 21). These steps are explained also in the procedure of data collection later in this chapter.

Another ethical issue that was considered carefully is the translation of the questionnaire and interview questions from English to Arabic and the participants' responses from Arabic to English and all other translations that were needed between these two languages during the research process. In this regard, all the translated materials were reviewed and verified by a translation expert to ensure the accuracy of the translation and to avoid any change in meaning.

4.3.4 Practical procedure of data collection

The data of this study was collected through seven stages as follows:

4.3.4.1 Obtaining permissions

Before collecting data, I applied for a certificate of ethical approval to conduct this research from the Graduate School of Education at the University of Exeter which included overview of the research, the participants and the ethical issues that need to be taken into account during the research stages (see Appendix 17). Also, an approval to conduct the research was obtained from the University of Hail which is the sponsor of my study and the university where this study was conducted (see Appendix 19). Moreover, permission from the Ministry of Education in Saudi Arabia was obtained to collect data in schools during the pre-service teachers' school placement (see Appendix 18). Finally, agreements from the participants who took part in the study were sought through the consent forms (see Appendix 22 for pre-service teachers' form, Appendix 23 for university tutors' form and Appendix 24 for head teachers' form). Before the participants signed the forms, they were provided with an information letter (see Appendix 25 for pre-service teachers' letter, Appendix 26 for university tutors' letter and Appendix 27 for head teachers' letter) in its Arabic version (see Appendix 28 for pre-service teachers' letter, Appendix 29 for university tutors' letter and Appendix 30 for head teachers' letter) explaining the research purpose and their rights during the study stages.

4.3.4.2 Pilot work

In this stage, I carried out a pilot study in order to verify and develop the instruments' questions, the suitability of wording, and the time required to complete the questionnaire and to answer the interview questions. Moreover, the pilot stage was useful in getting feedback from the participants about what should be highlighted in open questions regarding the factors that influence the pre-service teachers' use of ICT in education.

Piloting the questionnaire

Validity of closed-ended questionnaires is an important aspect in this stage. Pallant (2010, p.7) define the validity of a questionnaire as "the degree to which it measures what it is supposed to measure". The TPACK questionnaire was designed and tested by many experts and can be seen as a validated instrument to test the technological pedagogical content knowledge of the pre-service teachers (Koehler, 2011; Koh et al., 2013; Schmidt et al., 2009). However, the final version of the questionnaire was reviewed by several experts in the field including my supervisors.

Moreover, reliability of the questionnaire needs to be tested. Reliability is defined by Pallant (2010, p.6) as “the degree to which the items that make up the scale are all measuring the same underlying attribute”. She explained that the internal consistency can be tested in a number of ways and the most common test is Cronbach’s alpha which is available in the SPSS statistical package. According to Pallant (ibid), the value of the test is in the range from 0 to 1, a higher value indicates greater reliability. A value of alpha of greater than 0.7 is generally regarded as acceptable. Internal reliability of the seven TPACK constructs has already been established and scored high values in previous versions of the questionnaire that studied the same type of participants, namely pre-service teachers (Koehler, 2011; Koh et al., 2013; Schmidt et al, 2009). Table 4.2 below shows the reliability values of the TPACK questionnaire from these studies.

Table 4.2: Reliability of TPACK questionnaire (Koehler, 2011)

TPACK Doman	**Internal Consistency (alpha)**
Technology Knowledge (TK)	.86
Content Knowledge (CK)	
Social Studies	.82
Mathematics	.83
Science	.78
Literacy	.83
Pedagogy Knowledge (PK)	.87
Pedagogical Content Knowledge (PCK)	.87
Technological Pedagogical Knowledge (TPK)	.93
Technological Content Knowledge (TCK)	.86
Technological Pedagogical Content Knowledge (TPACK)	.89

However, due to the slight changes that have been made to the version used in this research (changing some wording and removing some items), it was necessary to test the internal reliability of each scale to ensure that the items were measuring similar constructs. Although this should have been done through this stage (pilot study), due to the small number of the sample (53 pre-service teachers) and the smaller number of the pilot study sample (eight pre-service teachers), which was not enough to test the internal reliability, I carried out the test after collecting data from the participants in the main study. This is explained in more detail in the quantitative analysis chapter.

In order to verify and develop the instruments' questions after the translation from English to Arabic (see Appendix 31 for science questionnaire and Appendix 32 for mathematics questionnaire), the suitability of the wording, and the time required to complete the questionnaire, I arranged a meeting with eight pre-service teachers (four mathematics and four science) with the help of the coordinator of school placement at the College of Education, University of Hail. During this 45 minute meeting I introduced my research and the questionnaire. Then they completed the questionnaire and wrote their comments about unclear items. It took them about 20 minutes to complete it. After I collected the questionnaires, I discussed its items and wording with them and I took notes. Only three items of the translated version of the questionnaire were not very clear to the participants, items 3, 4, and 19. When I explained them to the participants during the meeting, we agreed the change of the wording that made them clearer. The change was also reviewed by an expert in translation. This led to the final version of the Arabic questionnaire which was ready to be used to collect data (see Appendix 3 for science questionnaire and Appendix 4 for mathematics questionnaire).

Piloting the interview

I conducted pilot interviews with two pre-service teachers in order to verify the interview questions and check their wording after translation and the time needed for the interview. I found that all the questions were clear and understandable and needed about 45 minutes to be answered. To this end, the final version of the Arabic interview schedule was ready for data collection (see Appendix 13).

Piloting the observation

Classroom observations were conducted three times with each pre-service teacher. The reason for conducting three lessons (which was originally planned to be two lessons with each participant) is to ensure the quality of the focus of the observation and to take notes over a longer period with the participants in the classroom, looking at every observation as a pilot observation for the following one. I argue that increasing the number of the classroom observations would increase the quality of its data by the end of the data collection stages.

4.3.4.3 Preparing for data collection

At this stage, I visited 21 schools and had short conversations with the science and mathematics pre-service teachers as a group in each school and I wrote notes about their technology use and the possibility of their participation in my research. I was also provided with a team of four university tutors with the help of the school placement coordinator at this stage. They volunteered to help me in distributing and collecting the questionnaires among the pre-service teachers. I made sure that they would not deal with the pre-service teachers who were under their own supervision to avoid any authoritative influence that could affect the ethics of the study. I met the university tutors' team, introduced my research, gave them a brief explanation about the TPACK questionnaire, and we agreed to distribute the questionnaires according to the study timescale. Moreover, in this stage, I collected all the relevant documents mentioned earlier in this chapter. In addition, I had conversations with the head teachers about the regulations governing school placement in their schools and they provided me with the relevant documents.

4.3.4.4 Reviewing relevant documents

At this stage, reviewing of relevant documents started and continued throughout all the study stages. For example, I started reviewing the Saudi Arabian educational system policy, manual of the College of Education at the University of Hail, guideline of school placement, assessment forms of the pre-service teachers by the university tutors, head teachers, and cooperating teachers.

4.3.4.5 Administration of the questionnaire

At this stage, the final version of the questionnaire was distributed to the science and mathematics pre-service teachers with the help of the university tutors' team (including myself) covering 21 schools in the city of Hail. All the questionnaires were collected by the same team from the participants after giving them enough time for completion (28 science pre-service teachers and 25 mathematics pre-service teachers).

4.3.4.6 Conducting the classroom observations

After choosing the participants who agreed to participate in the classroom observation and interview, we agreed a timescale for conducting the classroom observations and pre-observation forms were given to them to provide information in advance about the lessons that would be observed. Prior to each lesson, I received the form from the participant and reviewed it to familiarise myself with the lesson and its objectives and contents.

As explained earlier, in the sample section, a purposive sampling strategy was used to select five pre-service teachers (three science and two mathematics) from those who had completed the questionnaires and indicated that they used technology in their teaching. Also, two pre-service teachers (one science and one mathematics) were chosen from those who indicated that they did not use technology in their teaching. I conducted three classroom observations for each of the participants who used technology and two classroom observations for each of the participants who did not use technology in their teaching, using the observation instrument that was designed for this purpose as mentioned earlier in this chapter. All the lessons observed were video-recorded after obtaining the relevant permission in order to enable them to be reviewed later if needed.

4.3.4.7 Conducting the interviews

At this stage of data collection, and after conducting the three classroom observations, I interviewed all the pre-service teachers who were observed at the previous stage. Interviews were conducted in their schools by making an appointment at times that suited the participants and booking a quiet room with the help of the schools head teachers in each school. In addition, four head teachers of the same schools were interviewed in their rooms after booking appointments with them. Moreover, four university tutors from those who supervise the pre-service teachers participating in the study were interviewed. I interviewed the university tutor at the university in their rooms after booking appointments for this purpose in advance and times that suited them to ensure that they are comfort during the interviews. Although I had previously planned to conduct more than one interview with each participant if needed, I found that I had collected all needed data through one interview and felt that the participants had said everything that could be said about the issue under investigation during the first interview. Also, the current study does not seek to capture ‘change over time’ among the participants, which made the single interview with each participant enough to provide the required data.

In interviews, it is recommended that the researcher uses a recording device. Yin (2009, p.109) asserts that “audiotapes certainly provide a more accurate rendition of any interview than any other methods”. However, there are some issues that need to be considered when recording interviews, such as ensuring that the participant is comfortable with the recording and giving their permission. I audio-recorded all the interviews after ensuring that the participants were happy with recording and they all gave their permission to be recorded. A summary of all types of data collected for this study is given in Table 4.3 below:

Table 4.3: Summary of the study data

Institutions	**Participants**	**Type of data**	**Duration in minutes**
All schools	28 Science ST 25 Mathematics ST	TPACK Questionnaire (Quantitative data)	20 on average
School 1	ST3 science	Classroom observations 1	45
		Classroom observations 2	45
		Classroom observations 3	45
		Interview	33
	HT1	Interview	43
School 2	ST4 math	Classroom observations 1	45
		Classroom observations 2	45
		Classroom observations 3	45
		Interview	41
	HT3	Interview	24
School 3	ST1 science	Classroom observations 1	45
		Classroom observations 2	45
		Classroom observations 3	45
		Interview	26
	ST2 science	Classroom observations 1	45
		Classroom observations 2	45

		Classroom observations 3	45
		Interview	36
	ST6 math no technology	Classroom observations 1	45
		Classroom observations 2	45
		Interview	44
	HT4	Interview	17
School 4	ST5 math	Classroom observations 1	45
		Classroom observations 2	45
		Classroom observations 3	45
		Interview	30
School 5	ST7 science no technology	Classroom observations 1	45
		Classroom observations 2	45
		Interview	34
	HT2	Interview	48
University	UT1	Interview	35
	UT2	Interview	44
	UT3	Interview	45
	UT4	Interview	37

4.4 Data analysis

In this section of the chapter, I present detailed information about the analysis of the data collected through questionnaires, semi-structured classroom observations and semi-structured interviews.

4.4.1 Quantitative data analysis

The quantitative data that was collected using the TPACK questionnaire was coded and then analysed using the statistical analysis package SPSS 20 as a powerful tool of quantitative data analysis. For example, for the pre-service teachers' teaching subject variable, science was given the code (1) while mathematics was given the code (2). Completed questionnaires were given ID numbers from 1 to 53 which is the whole number of pre-service teachers who completed the questionnaire. Following Koehler (2011), all the items of the questionnaire are positively worded and are scored according to Likert scale ranging from the value of 1 which indicates strong disagreement, 2 indicating disagreement, 3 indicating neither agreement nor disagreement, 4 indicating agreement, to 5 indicating strong agreement. Table 4.4 below shows how scores relate to the level of agreement and, in turn, to the perceived level of knowledge.

Table 4.4: Scores in relation to the level of agreement and the perceived level of knowledge

Score	**Level of agreement**	**Perceived level of knowledge**
1	Strong disagreement	Very low
2	Disagreement	Low
3	Neither agreement or disagreement	Not sure
4	Agreement	High
5	Strong agreement	Very high

As will be presented in greater detail in the quantitative findings chapter, the questionnaire data were analysed descriptively and inferentially. Scales of measurement of the seven knowledge areas (Technological Knowledge, Content Knowledge, Pedagogical Knowledge, Pedagogical Content Knowledge, Technological Content Knowledge, Technological Pedagogical Knowledge, and Technological Pedagogical Content Knowledge) were produced in order to compare the pre-service teachers' perceptions of their levels of knowledge on each of these areas. This is because a perceived deficiency in an area of knowledge might discourage pre-service teachers from implementing technology in the classroom, or a perceived strength in an area of knowledge might promote their use of technology in the classroom. This is further explored by the qualitative data analysis later, considering other aspects such as the influence of the context and social aspects which could not be explored by the questionnaire. Next, the data for each of the seven areas were examined in greater detail looking at mean scores and patterns of responses for each item individually to give a greater depth of understanding about the particular topics within a knowledge area that the pre-service teachers' find particularly easy or difficult. For example it may turn out to be the case that weakness in one particular aspect of knowledge may prove to be a key stumbling block to their implementation of technology in the classroom.

Subsequently, statistical tests (explained in greater detail in the next chapter) were carried out to compare responses by pre-service teachers' areas of specialism (teaching subject) in order to see whether the area of specialism has any effect on the pre-service teachers' perceived knowledge. Tests for normality were performed to see whether parametric or non-parametric tests should be used (see the quantitative findings chapter later); then the appropriate t-test or Mann-Whitney U Test was carried out to compare the mean or medians on the seven knowledge subscales by subject area. Lastly, cross tabulation was employed to compare responses to each item by subject area to detect any differences in the detailed responses.

After preparing the data file and carrying out the statistical tests, data and results files were saved and multiple copies were kept in several locations, such as my email, secure computer and a cloud account. This was to ensure the safety of the data and to enable access to them at any time. In addition, copies of the files were sent to my supervisors.

4.4.2 Qualitative data analysis

Raw qualitative data is a collection of constructions that are built by data collection methods and are reconstructed by data analysis process (Lincoln & Guba, 1985). In interpretive research, which is qualitative in nature, researchers make personal descriptions and assessments that fit the issue under investigation taking the context of the study and theoretical perspective into consideration, bringing the researchers' own perspectives to the interpretation (Creswell, 2012, p.238). Given the nature of this exploratory study guided by the sociocultural theory as its theoretical framework, thematic analysis is employed as the strategy of data analysis to analyse observation and interview data together. However, many theoretical aspects and analytical considerations need to be taken into account and made clear when using thematic analysis with sociocultural theory, as will be explained later in this section.

Thematic analysis is used in this study as "a method for identifying, analysing and reporting patterns (themes) within data" (Braun & Clarke, 2006, p.79). It is used to organise and describe data in rich detail. Many authors consider thematic analysis as a tool that can be used across different major analytical frameworks, such as grounded theory and sociocultural theory, to identify and locate themes within these frameworks (Boyatzis, 1998: Ryan & Bernard, 2000, cited in Braun & Clarke, 2006). I employed thematic analysis because it is a flexible means of analysis that allows for summarising of key features of the large amount of data and provides thick descriptions of it. It can also generate unanticipated insights and findings through the deep investigation of the issue. In addition, thematic analysis allows the consideration of social and personal aspects when interpreting data (Creswell, 2012, p.97). However, it is difficult to demarcate thematic analysis strategies or name its steps clearly. Therefore, Braun and Clarke (2006, p.93) recommend researchers to look at published examples that used similar versions of thematic analysis. In this study, several models of thematic analysis (e.g. Braun & Clarke, 2006; Creswell, 2012) and several published papers that used the same theoretical framework and analytical strategies were reviewed before conducting the analysis.

Thematic analysis is not a strategy of analysis that is wedded to a specific theoretical framework. It is actually a tool that can be used within different theoretical frameworks, such as grounded theory and sociocultural theory, offering researchers the opportunity to do many different things within them, as Braun and Clarke (2006) argue:

> *Thematic analysis can be an essentialist or realist method, which reports experiences, meanings and the reality of participants, or it can be a constructionist method, which examines the ways in which events, realities, meanings, experiences and so on are the effects of a range of discourses operating within society. It can also be a 'contextualist' method, sitting between the two poles of essentialism and constructionism, and characterized by theories, such as critical realism (eg, Willig, 1999), which acknowledge the ways individuals make meaning of their experience, and, in turn, the ways the broader social context impinges on those meanings, while retaining focus on the material and other limits of 'reality'. (p. 81)*

In this study, sociocultural theory (in addition to theories or concepts used under its umbrella such as identity, agency, affordances and the theory of planned behaviour) is used as the theoretical framework that guides the research process, carrying with it many theoretical aspects about the nature of knowledge that is produced from data and guides the research focus on data. Taking this theoretical stance into account, I attempted to make my theoretical position when conducting thematic analysis as clear as possible by organising the data according to the theoretical framework. Nevertheless, this approach also allowed the flexibility of thematic analysis to bring in the participants' voices without being strictly driven by theory. As this study holds to a constructionist perspective, meanings are deemed to be socially constructed. Therefore, through the use of a thematic analysis strategy, I attempt to theorise the use of technology in the classroom by the pre-service teachers in the light of the sociocultural context rather than focusing on individual psychology (Braun & Clarke, 2006, p.85). Through the use of thematic analysis within the sociocultural framework, I seek to strengthen this analytical strategy as the use of thematic analysis without any existing framework might limit its interpretive power and make the focus on data too broad. This is supported by Braun and Clarke's (2006, p.97) claim that "thematic analysis has limited interpretative power beyond mere description if it is not used within an existing theoretical framework that anchors the analytic claims that are made". I believe that using thematic analysis within the sociocultural framework allows me to focus on the social construction of the pre-service teachers' use of technology in the classroom, driving my data analysis toward the focus of the study and providing answers for my research questions.

In a basic thematic analysis that is not driven by a theory, patterns (themes) within a set of data are identified 'inductively' linking them to data and allowing data to speak about itself without a pre-existing framework (Braun & Clarke, 2006, p.83). In contrast, studies can adopt fixed theoretical thematic analysis, which is strictly guided by theories where themes are pre-determined 'deductively' based on the theoretical framework. This theoretical thematic analysis tends to negatively affect the richness of data description in general (Braun & Clarke, 2006, p.83). In the current study, in order to avoid both the limitations of theoretical thematic analysis and obtain the advantages of theory as a powerful tool to conduct research, open thematic analysis was conducted to code data inductively without fitting it into a pre-determined frame. However, the principles of sociocultural theory were considered and kept in mind during the data analysis process which provided the opportunity for the data to speak about itself yet keeping the study in its right theoretical direction at the same time. This was ensured previously by designing the interview questions according to the sociocultural focus and taking the power of social context in influencing the pre-service teachers' practice into consideration. It is worth mentioning that theory is used more explicitly later in the discussion chapter in order to interpret the findings and their meanings in the light of the study theoretical framework.

Miles and Huberman (1994) discuss this strategy as a thematic analysis strategy that lies between the inductive approach, where themes emerge from data, and the deductive approach, where themes are pre-determined. They argue that, in this strategy, according to the theoretical framework of the study, main categories are pre-determined, or at least pre-recognised by the researcher, while sub-categories are developed inductively. In the current study, the theoretical framework has driven its focus and framed its methods of data collection. However, when analysing data, the influence of the theoretical framework was implicit and limited to organising the focus of the research instruments and the researcher's thoughts and ideas during data analysis. As explained earlier, the theoretical framework is used mainly to design the study in its earlier stages and interpret its findings later in the discussion.

4.4.3 Data analysis process

To conduct data analysis in this study, I adopted Braun and Clarke's (2006) model of qualitative data analysis. Although the qualitative data analysis models that are suggested by many authors (see for example Creswell, 2012) are very similar and share the core ideas, Braun and Clarke's model divides the stages of analysis more finely. The model is suggested based on an open strategy of coding and making themes. The model consists of six stages: familiarizing oneself with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report (see Table 4.1 below).

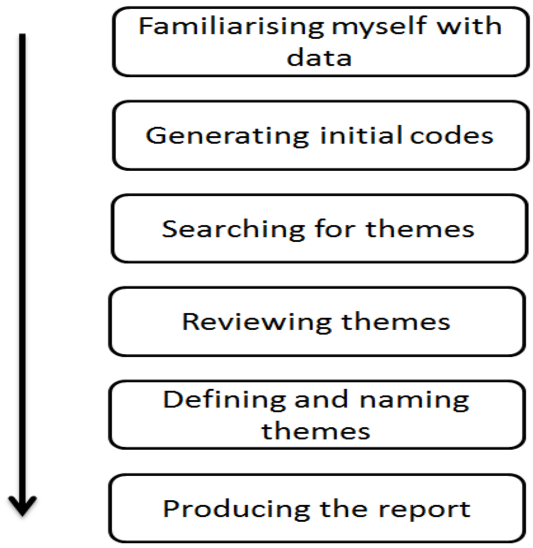


Figure 4.1: Representation of the data analysis process

4.4.3.1 Stage 1: Familiarising oneself with the data

In addition to the written texts in my data, which are the field notes from the classroom observations, I also collected verbal data from interviews with the participants. This kind of data needed to be transcribed into written texts before conducting the analysis. Creswell (2012, p.239) defines transcription as "the process of converting audiotape recordings or field notes into text data". In order to achieve this goal, I transcribed all the audio recorded interviews by myself by listening to them carefully and many times which allowed me to transcribe them accurately, considering every piece of information and writing the participants' responses as they were. Braun and Clarke (2006, p.88) argue that “the time spent in transcription is not wasted, as it informs the early stages of analysis, and you will develop a far more thorough understanding of your data through having transcribed it”. They add that transcribing verbal data should be regarded as a key stage of qualitative data analysis in interpretive research. Therefore, the time I spent in transcribing data by myself informed the analysis process as it allowed me to develop a deeper understanding of my data before moving on to the next stage of the analysis.

When I had all my data in text form, I started reading it several times in order to make general sense of it. This was also suggested by Creswell (2012) as a first stage of data analysis to explore the data and make general sense of it. At this stage, I wrote memos about the general ideas and thoughts about the organisation of the data. After that, I decided to look at the computer software that could be used to organise qualitative data analysis, such as NVivo and MAXQDA. By looking at their features and comparing them, I decided to use MAXQDA as the most suitable one for my study because it supports Arabic in addition to many other useful features. In this regard, I argue that analysing data in the participants’ native language would offer me many methodological and analytical advantages and increase the quality of the analysis. The language of the participants, their expressions and their verbal and non-verbal interactions can be seen as important parts of the context that inform researchers significantly. This becomes even more important in research that is informed by sociocultural theory, as the current study, where the context is seen as a central focus and extremely important in forming the situation under study. The translation of data into English would cause a loss of meaning and power formed by the context. Vallance, Madang and Lee (2005) argue that “the advantage of not needing to render idioms into English or translate expressions in ways that lose their immediacy, power and context is an important step towards a consistent interaction with the text that forms the data" (p.5). Therefore, one may argue that analysing data in the native language of the participants contributes to increasing the study's validity and trustworthiness. After engaging with the data in its original language, only examples of the extracts are chosen to exemplify every position or finding and translated from Arabic to English. Vallance et al. (2005) argue that:

> *Since only those passages selected for the written paper need to be translated into English, the resources of creativity and cultural situated-ness are concentrated on these relatively few passages. Hence, these selected passages can be translated into English with full regard to the meaning that will be conveyed to English speaking readers. (p.5)*

Moreover, MAXQDA software enables the combination of qualitative and quantitative data procedures as the latter was also a part of this study's data. Creswell (2012, p.243) argues that: "This Windows PC program is a powerful tool for text analysis that you can use for grounded theory-oriented 'code and retrieve' analysis as well as for more sophisticated text analysis. It enables you to combine both qualitative and quantitative procedures".

After importing all data files into the software, I organised them by type creating sub-groups of data (interviews, observations, and documents). Within these sub-groups, I gave a code to each file. For example, in the pre-service teachers' interviews sub-group, the pre-service teacher number one whose subject is science was given the code "PST1 sci" and the pre-service teacher number four whose subject is mathematics was given the code "PST4 math". In the university tutors' interviews sub-group, the university tutor number one was given the code "UT1" and so on.

4.4.3.2 Stage 2: Generating initial codes

After being familiar with the data in general by reading it several times, I started coding data at this stage. Coding is defined by Creswell (2012, p.243) as "the process of segmenting and labelling text to form descriptions and broad themes in the data". Although this study is theory-driven in that it is informed by sociocultural theory, I argue that coding data by an open coding strategy could provide richer description and deeper exploration of the issue. However, sociocultural theory principles informed the researcher's thoughts about the data and informed the later stages of interpreting the findings and making sense of its meaning in the light of the study framework, as explained in the theoretical consideration presented earlier in this chapter.

To generate codes, I started with the first interview in the list and read it several times, considering the underlying meaning of each piece of the participant's answers. I then started coding, 'labelling' all text segments that are interesting and could be related to the issue under investigation, keeping the research questions in mind all the time. I then moved to the other interviews, coding with the previously emerged codes or new codes as relevant. I finally came up with 158 codes generated inductively (see Appendix 33). It is worth mentioning at this stage that some extracts in the data were coded more than once as relevant. As argued by Braun and Clarke (2006, p.89): "you can code individual extracts of data in as many different 'themes' as they fit into, so an extract may be uncoded, coded once, or coded many times, as relevant". Table 4.5 shows an example of a data extract that was coded twice under two different codes.

Table 4.5: An example of multiple coding of the same data extract

Data extract	Coded for
Most importantly is the pupils' interest. They want to learn through lessons presented as PowerPoint presentations, video, images, this what made me keen to use technology all the time … the school atmosphere in general supports and requires the use of technology in education	• Images and video • Pupils interest in technology

4.4.3.3 Stage 3: Searching for themes

After coding all the data and producing a long list of codes, I moved to this stage of searching for themes. The aim of this stage was to broaden the focus on the data from the narrow codes to the wider themes or bigger ideas that contain several codes in common. Following Braun and Clarke (2006, p.89), this stage involved "sorting the different codes into potential themes, and collating all the relevant coded data extracts within the identified themes". Essentially, I analysed my initial codes, considering how different ones might have something in common, and then how they could be combined to form a wider idea or theme. With the help of MAXQDA software, it was easy and practical to move codes within the codes list and to group relevant codes under a theme or sub-theme. It also enabled me to write notes and brief descriptions for each code and emerging theme easily and in a well-organised way giving me a view over the whole data management in one window at the same time. Figure 4.2 below shows an example of the data imported to MAXQDA software and shows the different windows of row data, codes, themes and coded extracts.

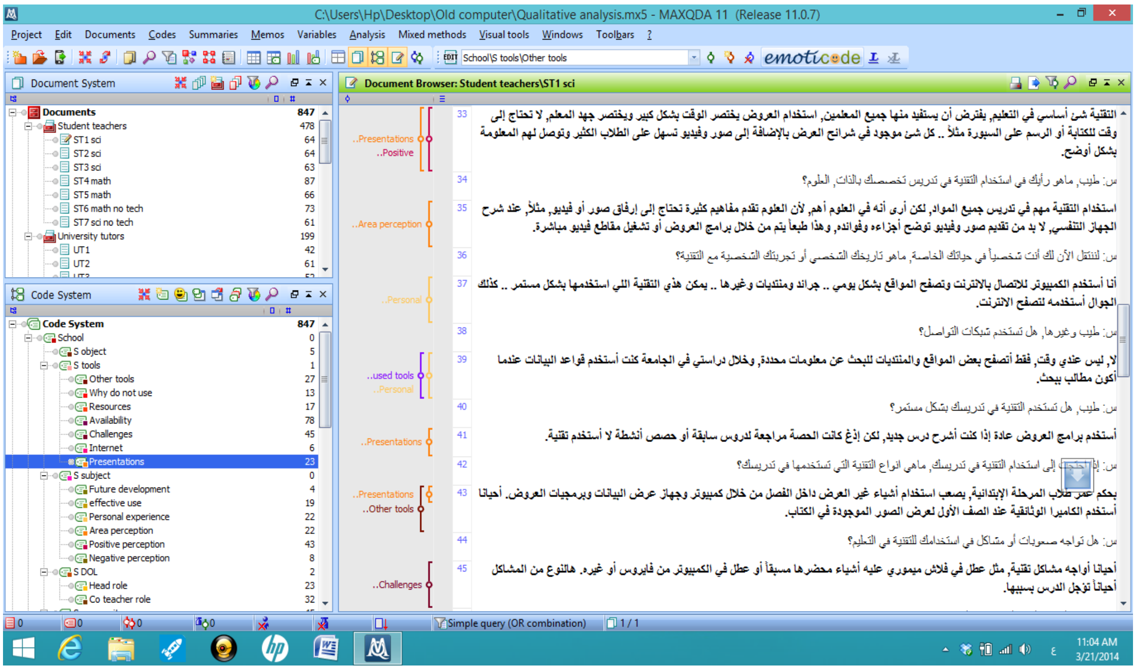


Figure 4.2: An example of qualitative data imported to MAXQDA software

During the process of searching for themes and categorising codes, some codes were combined to form main themes, whereas others were combined to form sub-themes, which in turn formed main themes. At the end of this stage, I came up with a theme map forming a collection of initial themes, sub-themes and codes and all data extracts related to each code. For an overview of this categorisation and the initial themes map look at Appendix 34. However, the rest of the data that was not coded in the previous stage was not abandoned by the end of this stage, rather it was looked at again along with the coded extracts as a whole in the next stage to ensure that no important data was missed during the initial coding.

4.4.3.4 Stage 4: Reviewing themes

In this stage, I started reviewing the themes that emerged and were formed in the previous stage. This was necessary to ensure the quality of the categorisation of the codes and sub-themes and main themes. During this stage, I recognised that some themes were not actually themes because the data was too diverse and contained different ideas. For example, the theme 'Availability of ICT equipment at school' contained several sub-themes and codes that might fit better in other themes, such as the 'pre-service teachers' perceptions of using ICT in the classroom' and the theme 'the influence of school settings'. This process was necessary to make sure that every set of data within each theme cohered meaningfully with the other sets of data and extracts under the same theme. In this stage, I focused on two levels of reviewing themes: the coherence of the data sets within each theme and the coherence of the whole theme map. By doing so, I made sure that the theme map and the relationships between themes and their components reflect the actual meanings emerging from the whole data set and their relation to the research questions. It is worth mentioning that during the current and the previous stages, I always re-read the whole data to make sure no important data were missing or un-coded and to make this process an ongoing process during the data analysis.

4.4.3.5 Stage 5: Defining and naming themes

After many turns of reviewing themes and codes within each theme, I reached an understanding about the whole story these themes were telling in relation to the research questions. At this point, I started defining and naming themes to reach the final version of the themes map. In this stage, I looked at each theme and its codes in detail to determine what part of the story this theme was telling and the aspects that its data captured relating to the pre-service teachers' use of technology. As a part of refining themes at this stage, I looked at the data extracts within each theme to make sure that each theme was internally consistent and the extracts were organised in a coherent way to provide a fluent narrative and identify a cogent story. The order and the name of each theme were considered carefully to fit well into the whole story. By the end of this stage, the scope and content of each theme were clear to me and the thematic map was able to tell the whole story in a coherent way. For an overview of the final thematic map see Appendix 35.

4.4.3.6 Stage 6: Producing the report

After producing the final version of the thematic map in the previous stage, I started the final analysis of the data and the writing-up of the report of the findings. The aim of this stage was to tell the whole complicated story in a narrative way. This included reporting the findings and providing evidence from the data itself as extracts to support every piece of the findings. All extracts chosen as examples in the report were embedded within an analytical narrative that attempted to go beyond describing the data by making arguments about the data presented in the light of the research question. Because the amount of qualitative data was quite large, and the thematic map was relatively complicated, the qualitative findings are presented in two chapters to make it easier to capture the story. The first chapter (Chapter Six) presents aspects related to the pre-service teachers' perceptions and experiences related to the use of technology in the classroom, while the second chapter (Chapter Seven) presents findings related to the influence of the practice settings on the pre-service teachers' perceptions and practices.

4.5 Research trustworthiness

Establishing trustworthiness is a major concern in qualitative research. While in quantitative research the process of ensuring the validity and reliability is a straightforward process through a statistical test, the quality of research in the qualitative enquiries has led to a great deal of debate among researchers. Over the past few decades, there has been a great effort by researchers to identify a list of criteria “that describes the characteristics of what constitutes good qualitative research” (Loh, 2013, p.4). One of the most influential attempts among researchers was that of Lincoln and Guba (1985), who introduced the term ‘trustworthiness’ to replace the terms validity, reliability and generalisability in quantitative research (Loh, 2013). According to Lincoln and Guba (1985), trustworthiness of research addresses the question: “How can an inquirer persuade his or her audiences that the research findings of an inquiry are worth paying attention to?” (p.290). This could be achieved through ensuring four criteria: credibility, transferability, dependability and confirmability. Therefore, this study considered these criteria in order to ensure the quality and establish trustworthiness.

4.5.1 Credibility

Credibility in qualitative research, which is equivalent to internal validity in quantitative research, is argued by Lincoln and Guba (1985) to be one of the most important standards that need to be met in order to ensure the study’s trustworthiness. Credibility can be achieved through many techniques, such as prolonged engagement, persistent observation, triangulation, peer debriefing, negative case analysis, referential adequacy and member checks. Therefore, in the current study, I have attempted to meet these criteria throughout all the study stages to ensure credibility. First of all, I attempted to maximise my familiarity with the study context in all its characteristics as this is a core point in case study research where the context play a major role in shaping the study and its findings. Actually, by choosing the University of Hail, I made sure of my familiarity with the context as I am a lecturer at this university and worked as a university tutor for several years with the pre-service teachers during their school placement. In addition, from an early stage of this research, I was always up-to-date with any changes occurring in the university programmes; I attempted regularly to receive any updated materials related to the teacher education programme in general and for school placement in particular.

Moreover, triangulation was one of the most important techniques adopted in this study to increase the credibility. This was achieved by employing three methods of data collection: questionnaire, classroom observation and interview. Also, three different groups of participants (pre-service teachers who were users or non-users of technology, university tutors, and head teachers) were chosen in order to allow investigating the issue from different angles and different perspectives, taking into account the various views of the different stakeholders involved in the pre-service teachers' training. The triangulation also included adopting multiple theoretical frameworks (see Section 3.6 in the previous chapter) to ensure maximising the focus on the issue in all its aspects and allowing accurate and effective theoretical interpretation of the study findings.

Furthermore, content verification (member checks) was employed as another technique to increase the credibility of this research. Classroom observation notes and interview transcripts were sent back to the participants in order to verify their contents and see whether the conversation written in the transcript match what they actually intended (Shenton, 2004). In addition, peer review was also another technique that was employed to ensure the credibility of the study. My data analysis and findings, in addition to the interpretation of these findings, were peer reviewed by academics and PhD candidates at several research events. All the feedback received from academics and PhD candidates was considered and has contributed, to some extent, in developing the study and increasing its credibility.

Examining previous research findings and addressing comparable issues emerging from them was a further technique employed in this study to increase its credibility. According to Shenton (2004), “the ability of the researcher to relate his or her findings to an existing body of knowledge is a key criterion for evaluating works of qualitative inquiry” (p.69). The previous literature was considered carefully in this study. The gap that this study occupies was identified through a thick revision of the literature and the interpretation of the findings was developed with concurrent revision of the existing knowledge.

4.5.2 Transferability

The second standard of research trustworthiness introduced by Lincoln and Guba (1985) is ‘transferability’, which is referred to as external validity in quantitative research. Shenton (2004, p.69) argues that “since the findings of a qualitative project are specific to a small number of particular environments and individuals, it is impossible to demonstrate that the findings and conclusions are applicable to other situations and populations”.

Although it is argued that results from case studies cannot produce generalisation in general (Silverman, 2010; Wellington, 2000), it is claimed that this kind of research strategy can allow transferability from the instance to a wider class (Cohen et al., 2010). In this study, as discussed earlier, the case study type can be seen as an instrumental case study because it provides insights into the science and mathematics pre-service teachers’ perceptions and practices related to the use of technology in the classroom among all the pre-service teachers in the whole country of Saudi Arabia, and possibly, the wider context of the Arab world due to the similarities between educational policies and systems, teacher education systems and cultural backgrounds within these contexts. Similarities between the programmes of teacher education within Saudi Arabian universities can be summarised as follows:

- All of the universities in Saudi Arabia are under the umbrella of the Ministry of Education and they follow its policy and organisation. However, there could be some slight differences in their programmes that will not affect the similarity between their programmes due to the general plan that they all follow (Alzaydi, 2010).
- All of the schools in the country are under the umbrella of the Ministry of Education and they all follow the same policy and apply the same curriculum. Moreover, teaching standards and requirements are supervised by the same policy including the integration of technology in education.

From the above discussion, I argue that, although this study can be seen as a unique case, some results might be transferred to other universities in Saudi Arabia that carry out similar teacher education programmes. Furthermore, while many studies have been carried out in developed countries such as the UK and the USA around the adoption of technology in education by pre-service teachers, this study seems to be one of the first attempts to explore this issue in Saudi Arabia according to the sociocultural theory perspective which could reveal important findings. Therefore, the results of this study may provide an insight into the possibility of transferring any similarity in factors that influence the use of technology in education among pre-service teachers which could arise from the findings of this study.

4.5.3 Dependability

Dependability is another standard suggested by Lincoln and Guba (1985) to ensure the trustworthiness of qualitative research; it parallels reliability in quantitative research. According to Shenton (2004, p.71), “in addressing the issue of reliability, the positivist employs techniques to show that, if the work were repeated, in the same context, with the same methods and with the same participants, similar results would be obtained”. In order to preserve dependability, the process of the current study was reported in clear detail which would allow other researchers to repeat the work in different situations considering the contextually unique factors of this study. Shenton (2004, p.71) argues that “such in-depth coverage also allows the reader to assess the extent to which proper research practices have been followed … so as to enable readers of the research report to develop a thorough understanding of the methods and their effectiveness”.

4.5.4 Confirmability

Confirmability is associated with the term ‘objectivity’ in scientific research. In humanities research, triangulation could contribute to increasing trustworthiness as a strategy of achieving confirmability (Lincoln & Guba, 1985). With the help of triangulation, I attempted to make sure that the findings of the study were reported according to the participants’ experiences and ideas rather than the experiences and ideas of the researcher to reduce the effect of the investigator’s bias (Shenton, 2004). However, this study is an interpretive one where the researcher’s perceptions play a major role in forming the study.

4.6 Summary of the chapter

This chapter has presented a detailed description of the research methodology and design followed to conduct this study. The research objectives, questions, and philosophical assumptions were presented at the beginning of the chapter. I then presented the methodology of the study including description of the sampling, research methods and instrument, ethical issues, and the procedure of data collection. Finally, I presented the data analysis process and theoretical considerations related to the analysis and concluded the chapter by discussing the trustworthiness of the research including credibility, transferability, dependability and confirmability. In the following chapter, I present the quantitative findings that emerged from TPACK questionnaire.

5 Quantitative Findings

5.1 Introduction

As mentioned earlier, in the methodology chapter, this study is mainly qualitative in nature. However, the TPACK closed-ended questionnaire was used to provide quantitative background information about the pre-service teachers' perceived technological pedagogical content knowledge. The questionnaire aims to answer the research question: 'What is the science and mathematics pre-service teachers' perceived technological pedagogical content knowledge (TPACK)?'

In Section 5.2, data are analysed for the whole sample. This begins in 5.2.1 with a description of how the questionnaire was scored, followed by 5.2.2 which describes process of ascertaining reliability of scales using Cronbach's alpha, and then 5.2.3 which presents means and standard deviation on the seven sub-scales of measurement of knowledge. Subsequently, in 5.2.4, means and standard deviations and patterns of responses are presented item by item. Section 5.3 analyses the results by the pre-service teachers' subject area. Section 5.3.1 deals with normality tests followed by tests for the differences between the means (or medians) on the seven sub-scales. Section 5.3.2 presents cross tabulations of response to individual items by subject area. In Section 5.4, the limitations of the questionnaire are discussed followed by the overall conclusion in Section 5.5.

5.2 Data analysis for the whole sample

The questionnaire consists of seven sub-sets of knowledge as described in 4.4.1. Following Koehler (2011) and Koh et al. (2013), each sub-set of items was made into a scale of measurement. Scores were arrived at for each these seven types of knowledge by combining the scores for the individual items relating to each type of knowledge. This enabled comparisons to be made between pre-service teachers' perceptions of each type of knowledge which may in turn affect their perceptions and practices related to the use of ICT in the classroom. It may also enable areas of weakness to be identified which could be remedied in the future. The scores for each type of knowledge were then examined in greater detail by looking at the responses to the individual items, and the mean scores and the standard deviations for individual items. This enabled me to identify particular aspects of each type of knowledge at which pre-service teachers feel that they are particularly strong or weak. This helped to interpret the scores for each type of knowledge and helped to elucidate pre-service teachers' choices as to when and how to use ICT in the classroom.

The descriptions of the results are for the whole sample as no differences were found between the participants according to their academic subject (this will be explained in detail later). As mentioned earlier, 53 questionnaires were given to the participants (the whole population of science and mathematics pre-service teachers at the University of Hail who were practising in schools in 2013). The response rate was 100% as the questionnaires were distributed and collected by members of staff who meet the participants regularly at schools. The questionnaire data were coded and scored as described in 4.4.1 earlier.

5.2.1 Producing knowledge scales

The internal reliability of the seven TPACK constructs has already been established (see Section 4.3.4.2). However, due to the slight changes made to the version used in this research, it was necessary to re-test the internal reliability of each scale to ensure that the items were measuring similar constructs, which was not done in the pilot study due to the small pilot sample size. To this end, Cronbach's alpha was computed for each knowledge scale. Where alpha was high enough, the mean score in each knowledge scale was computed for each of the 53 participants. For each knowledge type, the responses of each participant to the items within that knowledge type were averaged, giving a single score for each knowledge type.

Scales of measurement should ideally be uni-dimensional, that is each scale should measure just one construct, not a combination of constructs. This makes the interpretation clearer. A high value of alpha does not prove that a scale is uni-dimensional and it is possible for the high value of alpha to be obtained if the scale contains "two moderately correlated factors and with two uncorrelated factors" (Field, 2013, p.675). However, because the knowledge items in my study had already been divided into sub-scales measuring one aspect of knowledge each, it can be assumed that these sub-scales are uni-dimensional and therefore, alpha does measure the internal reliability of each sub-scale. In accordance with the recommendations of Field (2013, p.675), "if your questionnaire has sub-scales, alpha should be applied separately to these sub-scales". The values of Cronbach's alpha for each of the knowledge sub-scales are shown in Table 5.1 below.

Table 5.1: Cronbach's alpha for each of the knowledge sub-scales

Name of subscale	**Number of items**	**Cronbach's alpha**
TK Mean	7	.788
CK Mean	3	.760
PK Mean	7	.807
PCK Mean	2	.357
TCK Mean	3	.748
TPK Mean	7	.675
TPACK Mean	4	.785
Total	31	.916

All the 7 subsets of items have a high enough value of alpha (> 0.7) except for two subsets PCK and TPK. Alpha for TPK was almost 0.7. Alpha for PCK was only .357, which is quite low, and part of the reason is that PCK contains only two items. According to Field (2013, p.668), "the value of alpha depends on the number of items on the scale… as the number of the items in the scale increases, alpha will increase". Therefore, in the rest of this quantitative analysis, the limitations of PCK sub-scale should be kept in mind. The value of alpha for all the 31 items together was .916. This high value would be partly due to the large number of items but it may also have arisen from correlations between the knowledge factors.

5.2.2 Descriptive analysis of sub-scales

Table 5.2 below shows the mean scores and standard deviation of the knowledge sub-scales.

Table 5.2: Descriptive statistics

Sub-scale	N	Mean	SD
TK	53	3.95	.634
CK	53	3.79	.618
PK	53	4.12	.548
PCK	53	3.99	.616
TCK	53	3.79	.785
TPK	53	3.97	.531
TPACK	53	3.85	.638

The main point to emerge from Table 5.2 of descriptive statistics is that the mean scores on the seven types of knowledge were all greater than 3.0 on the 5 point scale, showing that on the whole the pre-service teachers agreed with the statements, meaning that they believed that they had a fair amount of knowledge of these topic areas. The highest mean score was for pedagogical knowledge (PK) at (M = 4.12) while the lowest was for content knowledge (CK) and technological content knowledge (TCK) at (M = 3.79) each. Clearly, there was not a great deal of difference between these mean scores. However, it surprised me that the pre-service teachers indicated higher pedagogical knowledge (PK) as they were only just starting to teach, compared to their content knowledge (CK) where they had been learning their science/mathematics for many years. The low technological content knowledge (TCK) score may also be a result of the pre-service teachers' relative low perceived level of content knowledge (CK).

The standard deviations, too, were all fairly similar at around (SD = 0.6) except for technological content knowledge (TCK) which was (SD = .785). This SD was particularly high probably due to one pre-service teacher who scored 1.00 on this scale, claiming to have no knowledge of TCK. This broadened the distribution and increased the SD. The lowest SD occurred for technological pedagogical knowledge (TPK) where the scores bunched closely around the mean.

5.2.3 Item by item analysis

In this section, I discuss the results for each sub-scale in detail item by item.

5.2.3.1 Technological Knowledge (TK)

For TK, from Table 5.1, the mean score was found to be (M = 3.95) and the standard deviation was (SD = .634). This shows that the pre-service teachers tended to agree with the seven items of TK (4 indicates agreement in the Likert scale). From this result it is clear that the pre-service teachers on the whole think that they have a high level of technological knowledge. In order to present the results in more detail, Table 5.3 below shows the item by item results showing the number of responses for each level of agreement, mean, and standard deviation.

Table 5.3: TK item by item statistics

Items		SD	D	N	A	SA	Mean	S.D.
TK 1	I know how to solve my own technical problems.	2	0	10	25	16	4.00	.920
TK 2	I can learn technology easily.	1	2	6	25	19	4.11	.891
TK 3	I keep up with important new technologies.	1	4	7	21	20	4.04	.999
TK 4	I frequently play around the technology.	0	7	9	22	15	3.85	.988
TK 5	I know about a lot of different technologies.	2	3	24	15	9	3.49	.973
TK 6	I have the technical skills I need to use technology.	1	3	11	23	15	3.90	.946
TK 7	I know how to use social networks (e.g. Twitter, Facebook)	2	2	1	22	26	4.28	.968

In this sub-scale, most of the items' means are around 4.0. The lowest mean was (M = 3.49) for TK5 and the highest mean was (M = 4.28) for TK7. Consistent with the overall mean for TK, most of the items have a very similar mean of around 4. This means that the pre-service teachers' perceptions are consistent across different areas of technological knowledge represented in five of these seven items. They feel that they can solve their own technical problems (TK1, M = 4.00), learn technology easily (TK2, M = 4.11), keep up with important new technology (TK3, M = 4.04), frequently play around technology (TK4, M = 3.85), and they feel that they have the technical skills they need to use technology (TK6, M = 3.90). On the whole, they are less confident that they know about a lot of different technologies (TK5, M = 3.49), while in contrast they have a higher level of knowledge about how to use social networks such as Twitter and Facebook (TK7, M = 4.28). The lower score in knowing a lot of different technologies (TK5) could indicate that the pre-service teachers might see technologies as a wide field of which they are only interested in a part. The higher score in the use of social networks (TK7) suggests that they are keen users of this kind of technology.

Looking in detail at the pre-service teachers' responses to the items, four out of the seven items showed a similar pattern of responses (TK1, TK2, TK3 and TK6). For example, for TK1, the most common response was "agree" (25 of the 53 respondents), the second most common response was "strongly agree" (16 respondents), while the third most common was "neither agree nor disagree" (10 respondents). Only a small minority expressed a measure of disagreement, with "strongly disagree" chosen by two respondents and no respondents selecting "disagree". This pattern explains the high mean score on these items.

Items TK4, TK5 and TK7 deviated from this pattern to some extent. In TK4, there seems to be a distinct minority of the pre-service teachers (7) who differed from the others in claiming that they do not frequently play around technology. However, the majority either agreed (22) or strongly agreed (15) with the item. It would be interesting to found out what was different about the seven pre-service teachers. TK5 differed from the other items in the large number of "neither agree nor disagree" responses (24). For TK7, a particularly large number of pre-service teachers selected "strongly agree" (26) and "agree" (22).

5.2.3.2 Content Knowledge (CK)

The mean score for CK from Table 5.3 was (*M* = 3.79) and the standard deviation was (*SD* = .618). This shows that the majority of the pre-service teachers tended to agree with all the three items in the CK sub-scale but not as strongly as on the TK sub-scale. From this result, it seems that the pre-service teachers on the whole believe that they have quite a high level of content knowledge. To present detailed results, Table 5.4 below shows the item by item results showing the number of responses for each level of agreement, mean and standard deviation.

Table 5.4: CK item by item statistics

Items		**SD**	**D**	**N**	**A**	**SA**	**Mean**	**S.D.**
CK 1	I have sufficient knowledge about my teaching subject.	0	0	13	30	10	3.94	.663
CK 2	I can use a mathematical/ scientific way of thinking.	0	2	18	29	4	3.66	.678
CK 3	I have various ways and strategies of developing my understanding of my teaching subject.	1	2	16	23	11	3.77	.891

From Table 5.4 above, most of items' means are a little lower than 4. The lowest mean was (*M* = 3.66) (CK2) and the highest was (*M* = 3.94) (CK1), consistent with the overall mean for CK sub-scale. This similarity in the mean scores shows that the pre-service teachers' perceptions are consistent across different aspects of content knowledge. They feel that they have sufficient knowledge about science or mathematics (CK1, *M* = 3.94) and they have various ways and strategies of developing their understanding of their subject areas (CK3, *M* = 3.77). However, they feel somewhat less confident that they can use a scientific/ mathematical way of thinking (CK2, *M* = 3.66).

Looking in detail at the pre-service teachers' responses to each item, all the three items showed similar pattern of responses. The majority of the pre-service teachers either agreed or strongly agreed with the three items. For example, for CK1, the most common response was "agree" (30 out of the 53 respondents), while 10 respondents strongly agreed with the item. On the other hand, no respondents indicated disagreement or strong disagreement, with the item, while 13 out of the 53 respondents chose “neither agree nor disagree”. This was similar to the other two items (CK2 and CK3) except for a minority of the pre-service teachers who either disagreed or strongly disagreed with the items (two disagreed with both of the items and one strongly disagreed with CK3). CK3 has the smallest mean of 3.66 (M = 3.66). This can be explained by the large number of respondents who chose “neither agree nor disagree” (18) with the item that they can use a mathematical/scientific way of thinking, amounting to about one third of the sample. This may be a cause for concern as they have been trained to be science or mathematics teachers but they were not confident about their ability to use a scientific or mathematical way of thinking.

5.2.3.3 Pedagogical knowledge (PK)

From Table 5.2, the mean score for PK was found to be (M = 4.12) and the standard deviation was (SD = .548). This value shows that the pre-service teachers, on the whole, agreed with the 7 PK scale items; this agreement is a little higher than for the TK and CK scales. From this result, it is clear that the pre-service teachers on the whole think that they have a high level of pedagogical knowledge. In order to present the results in more detail, Table 5.5 below shows the item by item results showing the number of the responses for each level of agreement, mean and standard deviation.

Table 5.5: PK item by item statistics

Items		SD	D	N	A	SA	Mean	S.D.
PK 1	I know how to assess student performance in a classroom.	1	0	0	24	28	4.47	.696
PK 2	I can adapt my teaching based-upon what students currently understand or do not understand.	0	0	10	32	11	4.02	.635
PK 3	I can adapt my teaching style to different learners.	2	1	12	26	12	3.85	.928
PK 4	I can assess student learning in multiple ways.	2	1	1	30	19	4.12	.878
PK 5	I can use a wide range of teaching approaches in a classroom setting.	2	0	5	24	22	4.21	.906
PK 6	I am familiar with common student understandings and misconceptions.	0	3	16	23	11	3.79	.840
PK 7	I know how to organize and maintain classroom management.	0	1	4	24	24	4.34	.706

In this sub-scale, most of the items' means are around 4.0. The lowest mean is (*M* = 3.79) (PK6) and the highest mean is (*M* = 4.47) (PK1). Consistent with the overall mean for PK (*M* = 4.12), most of the individual items have a very similar mean of about 4.0, indicating that the pre-service teachers' perceptions are consistent across different areas of pedagogical knowledge.

They feel that they have a high level of knowledge that allows them to adapt their teaching based upon what students currently understand or do not understand (PK2, *M* = 4.02), adapt their teaching style to different learners (PK3, *M* = 3.85), assess students' learning in multiple ways (PK4, *M* = 4.12), and use a wide range of teaching approaches in a classroom setting (PK5, *M* = 4.21). On the whole, they are more confident that they know how to assess students' performance in a classroom (PK1, *M* = 4.47) and how to organise and maintain classroom management (PK7, *M* = 4.34). However, they seem to be relatively less confident about their familiarity with common student understandings and misconceptions (PK6, *M* = 3.79).

Looking in detail at the pre-service teachers' responses to the items, four of the seven items showed a similar pattern of responses (PK1, PK4, PK5 and PK7). For example, for PK1, the most common response was "strongly agree" (28 of the 53 respondents), while the second most common response was "agree" (24 respondents) giving the total of 52 out of 53 either agreed or strongly agreed that they know how to assess students' performance in a classroom. Only one respondent strongly disagreed with this item.

Items PK2, PK3 and PK6 deviated from this pattern to some extent. For example, in PK6, 16 respondents chose "neither agree nor disagree" and 3 respondents disagreed with the item. This can explain the lower mean scores for the items in this pattern (PK2, PK3 and PK6) compared to the other items. However, the majority of the pre-service teachers responded with agreement or strong agreement with these items.

5.2.3.4 Pedagogical content knowledge (PCK)

For PCK, the mean score was found to be (*M* = 3.99) and the standard deviation was (*SD* = .616). This result shows that the pre-service teachers tended to agree with the two items on this sub-scale. From this result, it is clear that the pre-service teachers, on the whole, believe that they have a high level of pedagogical content knowledge. For more detail, Table 5.6 below presents the item by item results showing the number of responses for each level agreement, mean and the standard deviation.

Table 5.6: PCK item by item statistics

Items		SD	D	N	A	SA	Mean	S.D.
PCK1	I can select effective teaching approaches to guide student thinking and learning in my teaching subject.	1	1	15	24	12	3.85	.864
PCK2	I can address the common misconceptions my students have for my first teaching subject.	0	1	7	29	16	4.13	.708

Both of the two means of the items in this sub-scale are around 4.0. The mean for PCK1 is (M = 3.85) and for PCK2 is (M = 4.13). These results are consistent with the overall mean for the PCK sub-scale of (M = 3.99). This shows that the pre-service teachers' perceptions are consistent across the two areas represented by the two items. They believe that they can select effective teaching approaches to guide students' thinking and learning in science/mathematics (PCK1, M = 3.85). They also believe that they can address the common misconceptions their students have for science/mathematics (PCK2, M = 4.13).

Looking at the pre-service teachers' responses to the two items in detail, the majority of them either agreed or strongly agreed with the two items. For PCK1, 24 respondents agreed with the item and 12 strongly agreed, while only one respondent disagreed and one respondent strongly disagreed with it. However, 15 respondents chose "neither agree nor disagree" with the item. This can explain the lower mean that this item scored comparing to PCK2. For the latter, 29 respondents agreed with the item and 16 strongly agreed, while only one respondent disagreed and nobody strongly disagreed with this item. However, 7 respondents chose "neither agree nor disagree" when responding to this item.

In general, the pre-service teachers seem to be more confident in their ability to address the common misconceptions their students have than their ability to select effective teaching approaches to guide students' thinking and learning in science/mathematics.

5.2.3.5 Technological content knowledge (TCK)

The mean score for TCK was found to be (*M* = 3.79) and the standard deviation was (*SD* = .785).This shows that the pre-service teachers tended to agree with the three items of TCK sub-scale. From this result, it is clear that the pre-service teachers on the whole think that they have a high level of technological content knowledge. In order to present the results in more detail, Table 5.7 below shows the item by item results showing the number of responses for each level of agreement, mean and standard deviation.

Table 5.7: TCK item by item statistics

Items		SD	D	N	A	SA	Mean	S.D.
TCK1	I know about technologies that I can use for understanding and doing my teaching subject.	2	1	10	32	8	3.81	.856
TCK2	I can use any software that is created specifically for my teaching subject.	3	1	16	24	9	3.66	.979
TCK3	I can use appropriate technologies (e.g. multimedia resources, simulation) to represent the content of my first teaching subject.	2	3	10	21	17	3.91	1.04

From Table 5.7 above, most of the items' means are around 4.0 which is consistent with the overall mean score for TCK (*M* = 3.79). The lowest mean is (*M* = 3.66) for TCK2 and the highest mean is (*M* = 3.91) for TCK3. These results indicate that the pre-service teachers' perceptions are consistent across the three areas represented in the technological content knowledge items. They feel that they know about technologies that they can use for understanding and doing science/mathematics (TCK1, *M* = 3.81). They also feel that they can use appropriate technologies (e.g. multimedia resources, simulation) to represent the content of science/mathematics (TCK3, *M* = 3.91). However, they seem to be less confident, but still indicate a high level of knowledge, that they can use any software that is created specifically for science/mathematics (TCK2, *M* = 3.66).

Looking in detail at the pre-service teachers' responses to the TCK items, all the three items showed a similar pattern of response. For example, for TCK1, the most common response was "agree" (32 out of the 53 respondents), while 8 of them strongly agreed with the item. However, 10 respondents chose "neither agree nor disagree", while only a small minority expressed a measure of disagreement, with "disagree" chosen by one respondent and "strongly disagree" chosen by two respondents. This is similar to the other two items (TCK2 and TCK3) except for the larger number of respondents who neither agreed nor disagreed with TCK, which can explain the lower mean score for this item (*M* = 3.66).

5.2.3.6 Technological pedagogical knowledge (TPK)

For TPK, the mean score was found to be (*M* = 3.97) and the standard deviation was (*SD* = .531). This shows that the pre-service teachers tended to agree with the five items of TPK. From the results, it can be seen that the pre-service teachers believe that they have a high level of technological pedagogical knowledge. In order to present the results in more detail, Table 5.8

below shows the item by item results showing the number of responses for each level of agreement, mean, and standard deviation.

Table 5.8: TPK item by item statistics

Items		**SD**	**D**	**N**	**A**	**SA**	**Mean**	**S.D.**
TPK1	I can choose technologies that enhance the teaching approaches for a lesson.	0	3	12	24	14	3.92	.851
TPK2	I can choose technologies that enhance students' learning for a lesson.	0	2	13	21	17	4.00	.855
TPK3	My teacher education program has caused me to think more deeply about how technology could influence the teaching approaches I use in my classroom.	1	0	4	20	28	4.40	.793
TPK4	I am thinking critically about how to use technology in my classroom.	0	2	12	27	12	3.92	.781
TPK5	I can adapt the use of the technologies that I am learning about to different teaching activities.	0	3	20	25	5	3.60	.743

In this sub-scale, most of the items' means are also around 4.0. The lowest mean is (M = 3.60) for TPK5 and the highest mean is (M = 4.40) for TPK2. Consistent with the overall mean for TPK (M = 3.97), most of the items have a very similar mean of around 4.0. This shows that the pre-service teachers' perceptions are consistent across different areas of technological pedagogical knowledge. They believe that they can choose technologies that enhance the teaching approaches for a lesson (TPK1, M = 3.92), choose technologies that enhance students' learning for a lesson (TPK2, M = 4.00), and think critically about how to use technology in their classroom (TPK4, M = 3.92). On the whole, they are less confident that they can adapt the use of the technologies that they are learning about to different teaching activities (TPK5, *M* = 3.60), while in contrast they are more confident that their teacher education programme has caused them to think more deeply about how technology could influence the teaching approaches they use in their classroom (TPK3, *M* = 4.40).

Looking in detail at the pre-service teachers' responses to the items, three out of the five items showed a similar pattern of response (TPK1, TPK2 and TPK4). For example, for TPK1, the most common response was "agree" (24 of the 53 respondents), the second most common response was "strongly agree" (14 respondents), while the third most common response was "neither agree nor disagree" (12 respondents). Only a small minority expressed a measure of disagreement, with "disagree" chosen by three respondents and no respondents selecting "strongly disagree".

Items TPK3 and TPK5 deviated from this pattern to some extent. In TPK3, a particularly large number of pre-service teachers chose "strongly agree" (28) and "agree" (20), while only four respondents selected "neither agree nor disagree" and only one selected "strongly disagree". In TPK5, in contrast, a larger number of pre-service teachers chose "neither agree nor disagree" (20), 25 respondents chose "agree" and only five respondents chose "strongly agree", while three of them disagreed with the item.

5.2.3.7 Technological pedagogical content knowledge (TPACK)

The mean score for TPACK was found to be (*M* = 3.85) and the standard deviation was (*SD* = .638). This shows that the pre-service teachers tended to agree with the four items of TPACK. From this result, it is clear that the pre-service teachers, on the whole, think that they have a high level of technological pedagogical content knowledge. In order to present the results in more detail, Table 5.9 below shows the item by item results showing the number of responses for each level of agreement, mean and standard deviation.

Table 5.9: TPACK item by item statistics

Items		**SD**	**D**	**N**	**A**	**SA**	**Mean**	**S.D.**
TPACK1	I can teach lessons that appropriately combine content of my teaching subject, technologies and teaching approaches.	1	2	12	22	16	3.94	.929
TPACK2	I can select technologies to use in my classroom that enhance what I teach, how I teach and what students learn.	0	2	12	28	11	3.91	.766
TPACK3	I can use strategies that combine content, technologies and teaching approaches that I learned about in my coursework in my classroom.	0	4	14	25	10	3.77	.847
TPACK4	I can provide leadership in helping others to coordinate the use of content, technologies and teaching approaches at my school and/or district.	0	3	11	33	6	3.79	.717

From Table 5.9 above, it is clear that all the items' mean scores are slightly lower than 4.0. The lowest mean is (*M* = 3.77) and the highest mean is (*M* = 3.94). Consistent with the overall mean for TPACK (*M* = 3.85), all of the items have a very similar mean of around 4.0. This means that the pre-service teachers' perceptions are consistent across different areas of technological pedagogical content knowledge. On the whole, they believe that they can teach lessons that appropriately combine science/mathematics, technologies and teaching approaches (TPACK1, *M* = 3.94). They also think that they can select technologies to use in their classrooms that enhance what they teach, how they teach and what students learn (TPACK2, *M* = 3.91). They are slightly less confident that they can use strategies that combine science/mathematics, technologies and teaching approaches that they learned about in their coursework in their classroom (TPACK3, *M* = 3.77). They also feel less confident that they can provide leadership in helping others to coordinate the use of science/mathematics, technologies and teaching approaches at their school and/or district (TPACK4, *M* = 3.79).

5.3 Data analysis by subject area

5.3.1 Testing for differences between knowledge sub-scale means by subject area

In this section I explore whether there were any differences in the perceived knowledge scores between the science and mathematics pre-service teachers. Therefore, the mean score on each knowledge test was computed by subject area as shown in Table 5.10 below.

Table 5.10 Mean scores and standard deviation on each knowledge by subject area

Sub-scale	**Science N = 28**		**Mathematics N = 25**	
	Mean	**SD**	**Mean**	**SD**
TK	3.97	.777	3.94	.437
CK	3.70	.705	3.89	.497
PK	4.11	.644	4.14	.430
PCK	3.96	.543	4.02	.699
TCK	3.96	.716	3.60	.828
TPK	4.06	.452	3.86	.599
TPACK	3.85	.617	3.86	.673

Inspection of Table 5.10 shows that the means on each of the knowledge sub-scales for the science pre-service teachers were very similar for those for the mathematics pre-service teachers. For example, for TK, science pre-service teachers' mean scores was (M = 3.97) while the mathematics pre-service teachers' mean score was almost the same at (M = 3.94). On the other hand, the difference between the science pre-service teachers' mean (M = 3.96) on TCK and mathematics pre-service teachers' mean (M = 3.60) was a little bigger. To ascertain whether any differences between the means by subject area were statistically significant, it was necessary to carry out statistical tests.

In order to know whether the tests should be parametric or non-parametric, it is necessary to ascertain whether the distribution of scores follows the normal curve. Because the sample was a small one, the Shapiro-Wilk test was carried out to test for normality of distribution of the seven knowledge sub-scale. The results for the seven knowledge scales are shown in Table 5.11 below.

Table 5.11: Test for normality of distribution of the seven knowledge sub-scale

Knowledge	Shapiro-Wilk		
	Statistic	df	Sig.
TK Mean	.961	53	.081
CK Mean	.942	53	.012
PK Mean	.902	53	.000
PCK Mean	.925	53	.003
TCK Mean	.905	53	.000
TPK Mean	.955	53	.045
TPACK Mean	.958	53	.060

A significance level of >.05 indicates that the distribution is not significantly different from the normal distribution. From Table 5.11, the sub-scales TK and TPACK follow the normal distribution (TK p = .081, TPACK p = .060) so that parametric tests can be used with these sub-scales. On the other hand, all the other sub-scales had distributions that were significantly different from the normal distribution (CK p = .012, PK p = .000, PCK p = .003, TCK p = .000, TPK p = .045) so that non-parametric tests must be used with these subscales. The parametric test for the difference between the means of two independent samples is the independent samples t-test, so this test was conducted to compare the scores on TK and TPACK for science and mathematics pre-service teachers. The results are shown in Table 5.12 below.

Table 5.12: Independent samples t-test for TK and TPACK

		Levenes's Test for equality of variances		**t-test**		
		F	**Sig.**	**t**	**df**	**Sig.**
TK Mean	Equal variances assumed	8.997	.004	.183	51	.855
	Equal variances not assumed			.189	43.370	.851
TPACK Mean	Equal variances assumed	.052	.820	-.066	51	.947
	Equal variances not assumed			-.066	49.006	.948

There were no significant differences in scores on TK for science pre-service teachers (*M* = 3.97, *SD* = .777) and mathematics pre-service teachers (*M* = 3.94, *SD* = .437; *t*(43.370) = .189, *p* = .851, two-tailed). There were also no significant differences on TPACK for science pre-service teachers (*M* = 3.85, *SD* = .617) and mathematics pre-service teachers (*M* = 3.86, *SD* = .673; *t*(49.006) = -.066, *p* = .948, two-tailed).

The non-parametric alternative to the t-test is the Mann-Whitney U Test, which was therefore carried out on PK, CK, TCK, PCK and TPK for science and mathematics pre-service teachers. The results are shown in Table 5.13 and Table 5.14 below.

Table 5.13: CK, PK, PCK, TCK and TPK medians

Subject	**CK**	**PK**	**PCK**	**TCK**	**TPK**
Science	4.0000	4.1429	4.0000	4.0000	4.2000
Mathematics	4.0000	4.1429	4.0000	3.6667	3.8000
Total	4.0000	4.1429	4.0000	4.0000	4.0000

Table 5.14: Mann-Whitney U Test for CK, PK, PCK, TCK, and TPK

	CK	**PK**	**PCK**	**TCK**	**TPK**
Mann-Whitney U	295.500	349.500	305.500	255.500	282.500
Wilcoxon W	701.500	755.500	711.500	580.500	607.500
Z	-.995-	-.009-	-.818-	-1.715-	-1.213-
Asymp. Sig. (2-tailed)	.320	.993	.413	.086	.225

The Mann-Whitney U Test revealed no significant differences in the CK scores of science pre-service teachers (*Md* = 4.00, N = 28) and mathematics pre-service teachers (*Md* = 4.00, *n* = 25), *U* = 295.500, *z* = -.995, *p* = .320. It also revealed a similar result for PK scores of science (*Md* = 4.14, N = 28) and mathematics (*Md* = 4.14, N = 25), *U* = 349.500, *z* = -.009, *p* = .993. The same result was also found for PCK scores of science (*Md* = 4.00, N = 28) and mathematics (*Md* = 4.00, N = 25), *U* = 305.500, *z* = -.818, *p* = .413. Similar results were also found for TCK and TPK (see Tables 5.14 and 5.15 above) showing that there were no significant differences between science and mathematics pre-service teachers in these types of knowledge.

In conclusion, the tests revealed that the distributions of knowledge sub-scale scores were the same across subject areas. Thus, the slight differences in means were not statistically significant, showing that subject area did not affect pre-service teachers' perceptions of their levels of knowledge in each of the knowledge domains.

5.3.2 Comparison of item responses by subject area

For the 33 individual items, the patterns of response were compared using cross tabulation. It was not possible to perform the relevant statistical test (Chi Squared) to see whether the distributions of the responses were different because the expected frequencies in many of the cells were less than 5 (Pallant, 2010).

The following table (Table 5.15) shows the cross tabulation for item TK1 (I know how to solve my own technical problems), showing the actual counts and expected counts for the science and mathematics student teachers.

Table 5.15: TK1 cross tabulation

			TK1				
			Strongly disagree	**Not sure**	**Agree**	**Strongly agree**	Total
Subject	Science	Count	2	6	10	10	28
		Expected count	1.1	5.3	13.2	8.5	28.0
	Math	Count	0	4	15	6	25
		Expected count	.9	4.7	11.8	7.5	25.0
Total		Count	2	10	25	16	53
		Expected count	2.0	10.0	25.0	16.0	53.0

Table 5.15 shows that most of the pre-service teachers either agree or strongly agree that they know how to solve their own technical problems, while a minority is either not sure or strongly disagreed. Comparing the responses of the science and mathematics pre-service teachers, 10 science pre-service teachers strongly agreed with the statement compared to 6 mathematics pre-

service teachers, whereas the numbers expected to strongly agree were 8.5 and 7.5 respectively. The expected counts are derived from the distributions of the total counts, assuming that each group of pre-service teachers has the same pattern of response as the total, and also taking into account that there are slightly more science than mathematics pre-service teachers (28 compared to 25). Thus, the science pre-service teachers were slightly more likely to strongly agree than would be expected, while the mathematics pre-service teachers were slightly less likely to strongly agree. However, this pattern was reversed in the agree cells. Overall, there did not appear to be much difference in the responses of the two groups.

When this cross tabulations process was repeated for the other items, the actual distribution of counts did not seem to be very different from the expected counts. The item with the greatest difference was TCK2 (I can use any software that is created specifically for my teaching subject) which is presented in Table 5.16 below. (This is the only item on which the Mann-Whitney U Test showed a significant difference between distributions of responses by subject area).

Table 5.16: TCK2 cross tabulation

			TCK2					
			Strongly disagree	**disagree**	**Not sure**	**Agree**	**Strongly agree**	**Total**
Subject	Science	Count	1	0	5	16	6	28
		Expected count	1.6	.5	8.5	12.7	4.8	28.0
	Math	Count	2	1	11	8	3	25
		Expected count	1.4	.5	7.5	11.3	4.2	25.0
Total		Count	3	1	16	24	9	53
		Expected count	3.0	1.0	16.0	24.0	9.0	53.0

Here, for example, 16 science pre-service teachers agreed with the statement compared to an expected 12.7, whereas only 8 mathematics pre-service teachers agreed compared to an expected 11.3. So overall, science pre-service teachers were more likely to agree that they can use any software created specifically for their teaching subject, whereas mathematics pre-service teachers tended to be unsure about this. This may be because there is more science software available than mathematics software, for example materials on Youtube such as films of science experiments, animations, and films of natural phenomena which are so relevant to science.

To conclude, the responses of the science and mathematics pre-service teachers only showed one slight difference (TCK2) but in general pre-service teachers in both subject areas gave the same pattern of responses to the questionnaire items. This means that their perceptions of their knowledge were much the same whether they were science or mathematics pre-service teachers. For this reason, the questionnaire results were analysed for the whole sample in Section 5.2 above.

5.4 Limitations

The fact that the questionnaire was distributed by university staff members and collected by these members or head teachers could have affected the pre-service teachers' willingness to admit to weaknesses in their knowledge, accounting for the high scores on the scales. Although the questionnaires were anonymous, 45 out of the 53 participants wrote their names, emails and phone numbers on their questionnaire. I believe that was a cultural feature of the particular city of Hail where the study took place, where people see it as shameful not to provide as much as they can to anyone who asks a favour of them, such as completing a questionnaire. This could have had the unintended negative consequence of biasing their responses. However, the nature of the study and the rights of the participants were well-addressed and all the participants were aware of these rights through the questionnaire introduction. Also I made sure that the person who handled the questionnaire to them and collected it from them was not the personal tutor of the individual participant.

Other limitations are the small sample size (53) which would have reduced the ability to show up possible differences in responses by subject area and between the different knowledge areas. The small number of items in some of the sub-scales, notably TCK, and the consequent low value of Cronbach's alpha, may have limited the reliability of some of the measurement.

5.5 Summary of the chapter

What has emerged from the quantitative analysis is the pre-service teachers' perception that they have a high level of knowledge in all the seven areas. There were only minor differences between mean scores in TK, CK, PK, PCK, TCK, TPK and TPACK. Looking at the items individually, the scores all were within the range 4.0 plus or minus 0.5, indicating an agreement. The only exception was TK5 (I know about a lot of different technologies) which was the lowest scoring item with a mean of (M = 3.49) showing that they perceived that they only knew about a relatively narrow range of technologies, which could influence their use of ICT in the classroom. The item with the highest mean was PK1 (I know how to assess the student performance in a classroom) (M = 4.47) indicating confidence in this more traditional area of their pedagogical knowledge. No difference was found between science pre-service teachers and mathematics pre-service teachers' perceptions of their knowledge except for item TCK2 in which science pre-service teachers were more likely than mathematics pre-service teachers to agree that they can use any software created specifically for their teaching subject.

The quantitative findings may relate to the qualitative findings of the classroom observation and interviews in several ways. Firstly, the classroom observations should provide a check on the pre-service teachers' claimed high levels of knowledge. Having this information about the pre-service teachers' perceived level of knowledge should help to understand the ways that they use or do not use the ICT in the classroom and their perceptions about it. From the interview analysis, it may become clearer whether the pre-service teachers' claimed high levels of knowledge are justified and how their perceived knowledge might influence their perceptions and practices related to the use of technology in the classroom. Through the observations and interviews analysis, I should discover how the particular contexts in which the pre-service teachers work interact with their perceived knowledge to affect their use of ICT in the classroom and their perceptions about it.

6 Qualitative Findings (Part 1)

6.1 Introduction

In this chapter, I present the first part of the qualitative findings from the interviews and classroom observations. The reason for dividing the qualitative findings into two chapters is the large amount of findings that will be presented. Therefore, the current chapter presents aspects related to the pre-service teachers' perceptions of, and experiences with, the use of technology in the classroom while the next chapter (Chapter Seven) presents findings related to the influence of the practice settings on the pre-service teachers' perceptions and practices.

In this chapter I present findings related to the pre-service teachers' perceptions of using ICT in the classroom. This includes their views of the importance of technology use in the classroom. It then presents the participants' perceptions of the role of technology in teaching and learning from two different angles: users of technology vs. non-users, and science vs. mathematics. It also presents findings related to the pre-service teachers' beliefs development settings followed by challenges facing pre-service teachers' when using technology. The second part of this chapter presents findings related to the pre-service teachers' experience with technology. This sections consists of two sub-sections: technology use during university study and personal experience with technology.

6.2 Pre-service teachers' perceptions of using ICT in the classroom

This section presents findings related to the pre-service teachers' perceptions of using technology in the classroom as a tool for teaching and learning. It includes four sub-sections: 1) the importance of technology in education; 2) the role of technology - users vs. non-users; 3) the role of technology - science vs. mathematics; and 4) beliefs development settings - university study vs. teaching experience.

6.2.1 The importance of technology in education

Analysis of the interview and classroom observation data revealed that all the pre-service teachers, including those who did not use technology in their teaching, and regardless of their actual practice strategies, believed that technologies, such as PowerPoint presentations, internet, social networks and email communications between teachers and learners are regarded as an essential and important part of teaching and learning process nowadays. The following quote is an example that shows this belief:

> *'Technology is a very important thing for education now, I believe it should be used in all schools and in a serious and constant way in all school types; primary, middle and high schools ... presentations, internet, social networks, email between teachers and students themselves … technology is a very important thing for education … if it is used in an effective way education will improve.'* (PST2 science)

All the pre-service teachers who used technology in their teaching (five participants) indicated that they adopted some types of technology in their teaching because they were convinced of its importance in education. They believed that education should benefit from the development of technology. The following quotes are examples of these views about the use of ICT in the classroom:

> *'I use it because I believe in its important for teaching.'* (PST2 science)

> *'The use of technology is very important in education. There is a huge technological evolution. This must be well invested in education.'* (PST3 science)

When they were asked if they saw this importance more in their own teaching subjects, four out of five participants who used technology addressed the importance of using technology in all subjects. They believed that technology should be used when teaching all subjects and should not be limited to some of them. Both science and mathematics pre-service teachers indicated this view as shown in the following examples from science and mathematics pre-service teachers' interviews:

> *'I think technology can serve all subjects and is important in education in general.'* (PST3 science)
>
> *'Technology is important and must be used in all subjects teaching.'* (PST4 mathematics)

6.2.1.1 Technology improves teaching and learning

The analysis of interviews and observations data revealed that all of the five participants who used technology mentioned that the use of technology in the classroom could improve the pupils' learning and help in achieving the lessons' aims in a better way. However, some of them showed naïve views (as clarified in the following paragraphs) about the role and importance of technology use and its affordances in teaching. For example, one of the pre-service teachers (PST2 science) said that he used technology regularly because it helped him to deliver lessons in a faster and easier way by the help of PowerPoint presentations.

> *'I started using it because it can deliver information faster and easier through presenting the lesson in slides and using video clips and pictures.'* (PST2 science)

This naïve view about the role and affordances of technology in education could be because his lack of teaching experience. From the quote above, it seems that he decided to use technology at school focusing only on its function of facilitating information delivery, which sheds light on the importance of support and guidance for practice teachers. It also sheds light on the pre-service teachers' 'learning' during teaching practice which needs to be effectively oriented and supervised by the university tutors and school staff.

When the pre-service teachers talked about improving teaching and learning processes, they always referred to saving time and effort, achieving the lesson objectives in a better way, and organising teaching through the use of visual modes of technology such as PowerPoint presentations including images and videos. For example, one pre-service teacher (PST1 science) mentioned that with the help of PowerPoint slides, teachers did not need to spend time in writing. Another one (PST4 math) claimed that PowerPoint presentations helped him in organising lessons.

> *'The use of presentations saves time and saves teacher's effort significantly, you do not need time for writing or drawing on the whiteboard for example … everything is already in the presentation slides in addition to pictures and videos that facilitate many things for pupils, it facilitates information delivery and achieving the lesson's aims.'* (PST1 science)

> *'My opinion is that using technology saves time and effort and helps in organising lesson and its time through presentations' slides.'* (PST4 mathematics)

These views could also be seen as naïve as they focused on the basic functions and affordances that technology provides, such as saving time and organising lessons. Those pre-service teachers who held these views might have less awareness of the pedagogical affordances of technology that support the interactive learning styles and the active role of learners. Their views also seemed to be general views from a theoretical point of view which suggests that these views developed during taught modules during their university study. Looking at the TPACK questionnaire findings in the previous chapter, pre-service teachers seemed to perceive their level of technological pedagogical knowledge (TPK) as high. However, and according to their views about technology pedagogical affordances here, they seemed to focus on technological affordances only when dealing with technology and they attempt to employ it according to these perceived affordances such as organising lesson content and saving time.

Many other aspects of using technology in the classroom were seen by the pre-service teachers as elements that could improve teaching and learning. For example, a pre-service teacher explained that, in order to improve the teaching and learning process, pupils need to be taught with tools that they are familiar with, namely, technology as the feature of this generation. According to him, teachers must adapt their pedagogical strategies to satisfy the pupils' needs who have grown up with technology and it has become an integral part of their lives.

> *'Time has changed … I think pupils cannot learn without technology that became incredibly a main part of their daily lives.'* (PST1 science)

Another advantage of technology that was reported by the pre-service teachers as an element of improving the teaching and learning process was that it could help to overcome some problems related to the teachers themselves. One of them pointed out that using PowerPoint presentation helps teachers to overcome the problem of unclear hand writing on the whiteboard by preparing clear and attractive slides.

> *'Some teachers' hand writing is not clear; technology helps in solving this problem through presenting information in attractive and clear slides.'* (PST3 science)

In addition to the advantages of using technology in the classroom they addressed earlier, a pre-service teacher also added that using technology in the classroom could be beneficial for pupils as they would incidentally learn about technology itself although the aim of the lesson was to present something else.

> *'They benefit more, information delivered easily, and there will be a training for pupils in technology itself.'* (PST1 science)

Achieving 'creativity' in teaching was also mentioned by one pre-service teacher (PST2 science) to be a reason behind his adoption of technology in the classroom. He argued that teaching must be performed in a 'creative' way. From his point of view, creativity in teaching cannot be achieved without the use of technology in the classroom through visual presentations such as PowerPoint slides, images and videos. He thought that technology provided teachers with a great opportunity to be creative and that this would lead to more successful teaching.

> *'There has to be creativity, and creativity cannot be achieved in teaching without using new technology in the classroom and presenting videos and pictures.'* (PST2 science)

> *'As I said to you, technology provides you with an opportunity of creativity in presenting lessons and delivers information in an easy and interesting way. Technology gives you the ability to do so and provides prospects to more successful teaching.'* (PST2 science)

However, as this pre-service teacher adopted the traditional transmission strategy of teaching as noted during the classroom observation, it seems that creativity was seen by this pre-service teacher as using multiple resources and tools including visual representations of the science topics through technology. He did not seem to mean that pupils learned more creatively as they did not have an active role during lessons. His traditional transmission strategy of teaching using technology was noted during the three classroom observations conducted in his lessons. The following field notes are examples from the first classroom observation where he was teaching the concept of 'energy'.

> *'He used PowerPoint slides to present the content and explain it in a lecture style lesson. He continued presenting types of energy in the slides providing some images about the concept presented.*

He finished his presentation in about half an hour, and started asking the pupils about what he presented to make sure they understood the lesson.' (Observation 1, PST2 science)

The university tutors' expectations of creative teaching was also mentioned by this pre-service teachers to be a reason for using technology in order to demonstrate the ability to teach creatively with the help of technology. However, as mentioned earlier, there seem to be an issue in this pre-service teacher's understanding of the concept of creativity in teaching.

'The tutor expects me to teach in a creative way, to examine my ability of delivering lessons in an easy and interesting way to the pupils … technology allows me to achieve that.' (PST2 science)

Although this pre-service teacher seemed to adopt the traditional transmission method of teaching, he showed a strong belief that this type of strategy was not sufficient. He argued that traditional teaching is 'old fashioned' teaching that should be developed into more 'modern' and creative teaching strategies employing technology.

'Traditional teaching is an old fashioned strategy; almost all schools have technology equipment and resources.' (PST2 science)

However, he thought that, by using technology as a tool to support this style of teaching, he had moved from 'traditional' towards 'creative' teaching. He seemed to differentiate between teaching styles (creative vs traditional) according to the tools used; technological or non-technological. This issue might indicate a lack of pedagogical knowledge, which sheds light on the university programme's structure and the modules related to pedagogy. It could also highlight the importance of receiving support and supervision during teaching practice which should play a vital role in forming his ideas about teaching and learning.

This pedagogical issue also existed among the other two science pre-service teachers who used technology in their teaching. As noted during the classroom observations, they both adopted a similar teaching style (lecture style) and a similar use of technology to that of their previous colleagues. They also seemed to think that, by using technology, they had moved away from being traditional teachers. They argued that traditional teaching through non-technological tools is no longer sufficient as technological development offers more resources and should be invested in education to improve teaching and learning processes. The following two quotes are examples of this perception:

> *'I think that the use of technology is very important in education. There is a huge technological revolution; this must be well invested in education, we should move forward from teaching through old teaching methods.'* (PST3 science)

> *'Technology has become an essential part of the learning process, we must take its advantages … I don't think teaching through a whiteboard and a pen is enough these days.'* (PST1 science)

The following diagram (Figure 6.1) summarises the advantages of technology in improving teaching and learning that were reported by the pre-service teachers.

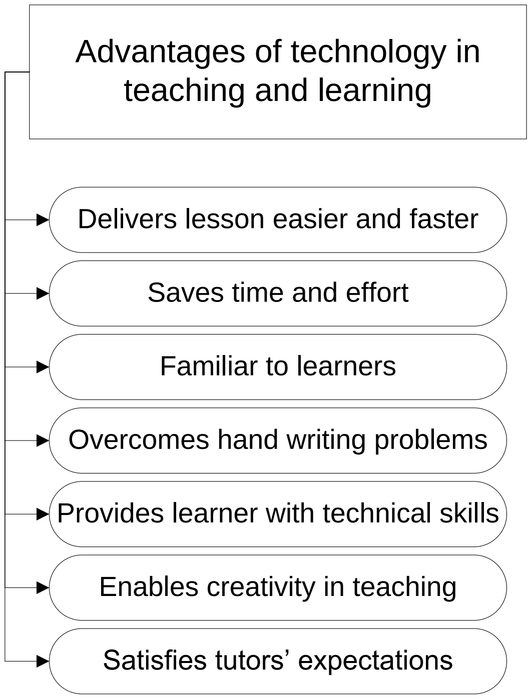


Figure 6.1: Advantages of technology in improving teaching and learning

6.2.1.2 Visual modes of technology as the ideal for primary school

Among all the pre-service teachers who used technology, visual modes of technology such as PowerPoint presentations that contain images and videos seemed to be first in mind when they talked about using technology in the classroom. Four out of the five pre-service teachers indicated that visualising concepts through technology is the appropriate representation for the school level of primary school and the age range of the pupils (from 6 to 11 years old). For example, a science pre-service teacher (PST2 science) mentioned the visual representations of scientific concepts through technology when he was asked about technology use in the classroom. This was probably because he only used this type of technology in his teaching, as noted during the classroom observation prior to the interview, due to his view of its appropriateness for the pupils’ age in primary school.

> *‘I talk about [PowerPoint] presentations particularly because it is the only technology I use and it is the only appropriate technology for the*

> *pupils' age … successful presentation is comprehensive and includes the lesson information, definitions, supported by pictures and videos, this will draw the pupils' attentions and is interesting to them.' (*PST2 science)

It seemed that this pre-service teacher believed that PowerPoint presentation is a good tool because of its appropriateness in presenting the lecture style lessons consistent with his teaching approach. It might be that being a 'traditional' teacher limited the choice of technologies could be used in teaching and learning for this pre-service teacher and limited his view of the affordances of this type of technology which could be used to perform an effective interactive lesson.

Similarly, another pre-service teacher (ST4 math) described the visual mode of technology such as PowerPoint slides, images and videos as technology 'number one' for primary school, which is sufficient for drawing the pupils' attention and making the lesson interesting.

> *'I think using presentations through a computer and a projector is the most important technology … it is technology number one in primary school. I think it's enough to draw the student attention and make the lesson interesting.'* (PST4 math)

Again here, this pre-service teacher seemed to limit the affordances of this type of technology in drawing learners' attention during a traditionally presented lesson, which suggests that pre-service teachers might only show an interest in tools that support their teaching strategies. Therefore, they might be less aware of the other technologies and the affordances they could provide for other teaching strategies that teachers need to be aware of. This issue might also raise a question about the pre-service teachers' identity and their understanding of agency. As they focus on affordances that serve the traditional transmission strategy of teaching, they might think about themselves as the active agents in the classroom and the pupils as the instruments of their strong agency. This will be discussed in more detail in the discussion chapter later.

The other advanced types of technology seemed to be difficult to use in primary school according to another pre-service teacher's view (PST1 science). He also argued that visual representation of topics through technology is the only appropriate technology to be used in the classroom in primary school. This pedagogical view can be seen clearly in the following quotes from his interviews:

> *'Considering the pupils' age in primary school, it is difficult to use other types of technology except [PowerPoint] presentations in the classrooms through a computer, a projector, and presentation software.'* (PST1 science)

Another pre-service teacher (PST5 math) agreed with his previous colleagues but he only seemed to be confident in using PowerPoint presentations and not aware enough of the other types of technology. However, this pre-service teacher indicated that he did not feel confident in using technology in general and that the co-operating teacher had encouraged and supported him in using presentations in teaching.

> *'I ask someone who is expert, usually the cooperating teacher. He prepared the presentation for me before the lesson when I needed it, my experience is small to some extent in dealing with such technology.'* (PST5 math)

The following field notes from his classroom observation also confirm this view.

> *'PowerPoint slides were prepared by the cooperating teacher and ready to be presented; he left the classroom when the lesson time began.*
>
> *He presented the slides briefly and started using the traditional whiteboard to write examples and exercises.*
>
> *He quotes exercises from the textbook and did it on the whiteboard with the student.'* (Observation 1, PST5 math)

This support and encouragement by the cooperating teacher could have formed the student teacher's belief about the appropriateness of visual modes of technology for primary school, which sheds light on the importance of school setting as a learning environment for the pre-service teacher. Interestingly, the lack of technological skills this pre-service teacher had might have increased his readiness to learn at school during his teaching practice, unlike the other pre-service teachers who seemed to be less influenced by the school setting in this regard because they had already developed their views and skills, to some extent, during their university study prior to teaching practice at school.

> *'I only use presentations through computers and projectors. This is the appropriate technology for mathematics and for primary school pupils specifically, I am not sure about the other types of technology … I do not know.'* (PST5 math)

In the same regard, two science pre-service teachers (PST1 science and PST3 science) argued that the appropriateness of the visual representation of scientific concepts through technology for primary schools was confirmed by the pupils themselves. They indicated that they used PowerPoint presentations in teaching science lessons because they could feel the strong desire of pupils to learn with a type of technology that is rich in multimedia resources such as videos, audio and images. The interest in this type of technology among learners might be seen by the pre-service teachers as an indication of its 'appropriateness'. This could confirm what was claimed previously about the pre-service teachers' learning during their teaching practice at school. One of the science pre-service teachers (PST1 science) regarded this desire of pupils as an important element that encouraged him to adopt technological visual representation of science topics in all lessons.

> *'What is more important is the pupils' desire … pupils like to learn through lessons presented as presentation slides, pictures and*

videos, this is what made me always keen on using presentations.' (PST1 science)

The other pre-service teacher (PST3 science) also said that he used PowerPoint presentations because pupils liked it. He said that pupils always asked him explicitly to prepare lessons as PowerPoint slides especially if there were videos and images included.

'I can feel the pupils' desire to learn through new technologies particularly presentations such as PowerPoint. They even ask me explicitly to prepare lessons to them and provide it through presentations include video and pictures.' (PST3 science)

In addition to the appropriateness of visual representations and the pupils' interest in such technology, saving time and effort was also mentioned by the participants as a reason behind their use of PowerPoint presentations. They explained that using PowerPoint presentations saved their time and effort of writing information on the classic whiteboard in the classroom and provided more quality and accuracy when presenting visual objects such as shapes through technology than when the pre-service teachers drew it by hand. This view seemed to be more oriented to the technological affordance of PowerPoint presentation without taking its pedagogical affordances into account. It seemed that the pre-service teachers wanted to use this type of technology to provide better writing on the board than their hand writing and more accurate shapes and objects in the case of mathematics for instance. These points can be seen in the following examples from the participants' interviews:

'Using presentations saves time significantly and saves the teachers' effort. You do not need to spent time in writing or drawing on the white board for example, everything you need exists in the slides in addition to pictures and videos that facilitate the pupils' learning and deliver information clearly and easily.' (PST1 science)

'If there is drawing in the lesson such as diagrams, shapes like triangles and squares, I use presentations where these thing are ready, this saves time and effort of drawing by hand and presents them more accurately.' (PST5 math)

Furthermore, pre-service teachers indicated that they used visual types of technology particularly, such as PowerPoint presentations, because it was the only type available at school. Therefore, the availability of specific types of technological tools seemed to be an influential element. Also, their adoption of this type of technology was found to be a solution applied by the pre-service teachers to overcome the issue of the lack in other non-technological tools such as drawing tools in mathematics. One pre-service teacher (PST4 math) stated that PowerPoint presentations were a good alternative to presenting diagrams and shapes with the lack of other tools in school, such as compasses and protractors.

> *'There are no drawing tools available in the school, because of that I can present accurate drawing through presentations … this also saves time and effort and present an interesting lesson.'* (PST4 math)

The following diagram (Figure 6.2) summarises the reasons for adopting visual modes of technology (PowerPoint presentations, video and images) in particular for teaching and learning in primary school.

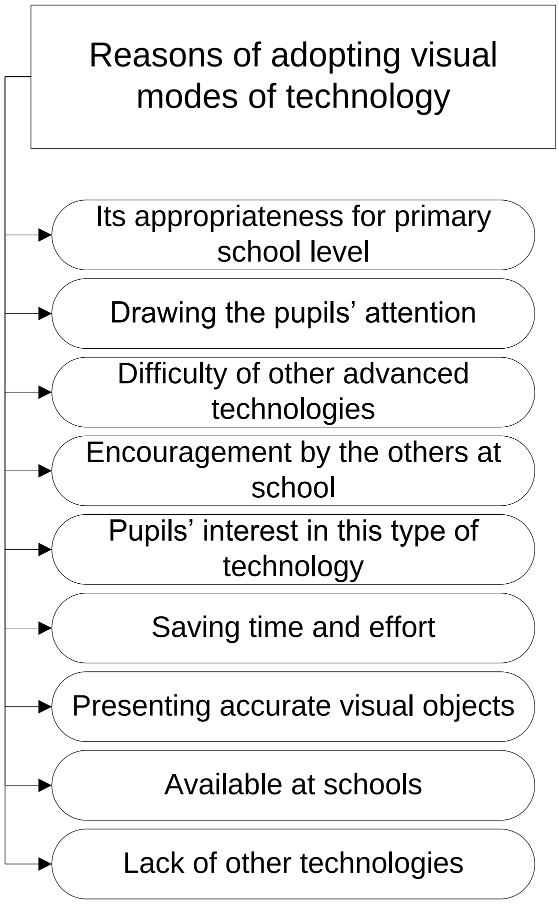


Figure 6.2: Reasons for adopting visual modes of technology

6.2.2 Technology role: users vs. non-users

From the above findings related to those who used technology in their teaching, it can be argued that they used it because the required technology that suited their teaching strategies was available at school. The availability of visual modes of technology, such as PowerPoint software that supported the traditional transmission strategy of teaching, seemed to be an important element that encouraged them to use technology. On the other hand, one of those who did not use technology (PST6 math no tech) indicated that the technology equipment that would suit their learner-centred teaching strategy, such as a computer lab, was not available at the school. This pre-service teacher's adoption of the learner-centred strategy was also confirmed during the classroom observation where he was teaching the concept of shape symmetry for year three pupils, as can be seen in the following field notes.

> *'He introduced the concept of symmetry through drawing some shapes on the whiteboard, then he distributed a number of A4 papers containing some different shapes … he asked them to look at the shapes and try to apply the symmetry concept to these shapes … He asked them to apply the symmetry concept on the classroom contents such as the whiteboard, door, desks, and books … he drew some shapes on the whiteboard and let pupils try to draw the symmetry line on the board in turn.'* (Observation 1, PST6 math no tech)

This pre-service teacher expressed the view that technology should be integrated into interactive teaching and argued that traditional teaching strategies using non-technological tools were not enough. However, he did not use technology because he thought that the required equipment was not available at the school and there was not enough training to use technology. He argued that the available technology only permitted presentations that transferred what was in the book to the screen. This different view could highlight the different pedagogical view about the use of technology in the classroom that this pre-service teacher held in which he saw 'no point' in using visual modes of technology that only transferred what was already in the textbook to the screen in front of the pupils. He seemed to believe more in technologies that would allow interaction and communication between teachers and learners, as will be seen later in this chapter. He also seemed to hold a different view about agency and the role of pupils during lessons, where they should be given more active roles and control over their learning. However, his views about the affordance of available technology (computers, projectors and presentation software) seemed to be another naïve view about the role of these technologies as they might be used to support interactive lessons.

> *'I do not use technology currently because of that the available technology is only presenting the book content in the screen, pupils copy answers to their notebooks, what is the point of using technology in this case?'* (PST6 mathematics no tech)

This pre-service teacher seemed to have a different pedagogical view than his other colleagues about the value of technology in the current situation in school where the whole setting was not prepared and the pupils were not ready to engage in such experience which seemed to be the reason behind his avoidance of technological tools. He said that technology use needed to be developed as a whole system including the provision of necessary equipment and preparing pupils and their families for technology use. This can be seen in the following quotes from his interview:

> *'There should be at least an interactive whiteboard, and when there is one, pupils should be prepared for its use. If the pupil and his family are not dealing with technology, what is the point? Our pupils are not ready to deal with technology … this is what I see.'* (PST6 mathematics no tech)

In short, I initially thought that those who used technology regularly would tend to adopt more learner-centred strategies than those who did not use it, due to its affordances, but when I went through the observations and interviews I came to realise that the main reason for using technology was to improve the traditional transmission way of teaching (teacher-led strategy) where the pre-service teachers presented their own work to the pupils through visualising scientific concepts technologically. Interestingly, it seems that those who did not use technology held pedagogical views in favour of constructivist and interactive learning because they mentioned that they would need more advanced technology and preparation in order to integrate technology into their teaching. In this view, technology could play a vital role in creating an interactive learning environment, while those who did use technology may have held traditional ideas about teaching and learning. In other words, the pre-service teachers who used technology regularly used it as a ‘traditional’ tool, while those who did not use technology seem to use the non-technological tools as interactive learning tools. This idea was revealed in the participants’ interview analysis where those who used technology saw its job as to attract pupils’ attention during a traditional lesson and believed that PowerPoint presentation was ‘enough’ to do this job. On the other hand, one of those who did not use technology stated that the available technology ‘only’ enabled transfer of the book contents to the screen, so he used non-technological tools to create a more interactive learning environment instead. The following two quotes are examples of these two different pedagogic values.

> *‘In order for technology use to be effective, it should have a role in drawing the pupils’ attention and making them interested in the lesson. If this is achieved, then technology use is effective … I think using PowerPoint presentations is enough to do this job.’* (PST4 math)

> *‘I do not use it currently … why? Because the available technology is only presenting what is already in the book, such as information and exercises, on the screen and presenting their answers; the pupils then copy them to their notebooks. What is the point of using technology in this case?’* (PST6 math no tech)

The following diagram (Figure 6.3) summarises the differences of views between users and non-users of technology.

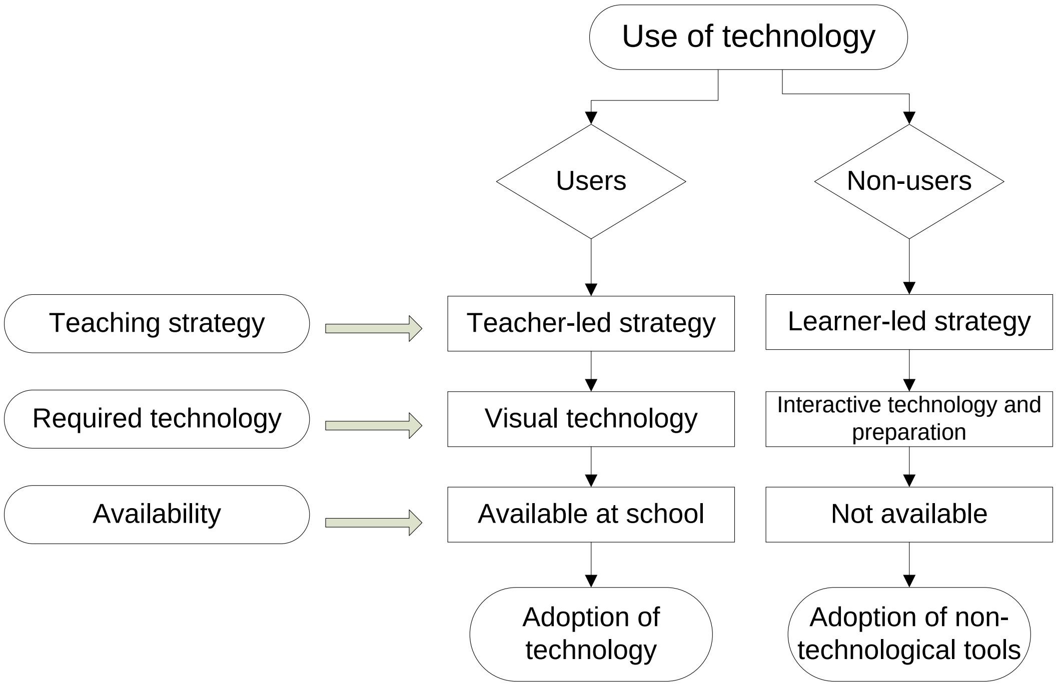


Figure 6.3: Difference of views between users and non-users of technology

6.2.3 Technology role: science vs. mathematics

Analysis of the interview and observation data revealed that technology, particularly PowerPoint, was the main tool that ‘replaced’ non-technological tools in science lessons, while it was an ‘additional’ tool in the mathematics lessons beside the non-technological tools that were seen by the mathematics pre-service teachers as more important for their lessons. This section presents this issue in more detail.

6.2.3.1 The ‘replacement’ function of technology in science lessons

Two of the three science pre-service teachers who used technology indicated that technology use was even more important for science teaching than any other subject due to the dynamic nature of science lessons that needed to be supported by multimedia resources, such as video and images, which could facilitate the complex and difficult concepts and process that are presented to the pupils. A pre-service teacher (PST1 science) believed that technology was especially important for science where many complicated concepts were presented to pupils. He argued that such concepts could be facilitated by visualisation through technology, such as presenting videos or images for a specific lesson. He gave an example when teaching the human body, such as the respiratory system, which needs to be visually presented through videos and images showings its parts and functions. This pre-service teacher thought that the best way to present video and images was through PowerPoint presentations, as can be seen in the following quote:

> *'Using technology is important for teaching all subjects, but is more important for science I think, because science lessons present lots of concepts that need to be supported by video and pictures. For example when teaching respiratory system in the human body, it is important to present pictures and videos showing its parts and functions … this can be achieved properly through PowerPoint presentations or playing videos directly.'* (PST1 science)

When talking about using technology in science lessons, pre-service teachers always mentioned the difficulty and complexity of some concepts in science which required using technology to visualise these concepts. This was mentioned by another science pre-service teacher (PST2 science) where he highlighted the importance of technology for science due to the advanced and complex level of some of the information delivered to the pupils. He gave an example of this complexity when he presented a lesson about space and the solar system. He believed that pupils would not be able to understand this lesson without visualising this topic by presenting video and images through a PowerPoint presentation telling the story of the star's birth and the planets' orbits. This can be seen in the following quotes from his interview:

> *'Using technology has a special importance in teaching science. I think … there are difficult and, to somewhat, advanced subjects even for the teacher himself … using projector and presentation software could facilitate understanding these subjects through videos and pictures … for example when teaching a subject about the space,*

> *stars birth, and solar system … it is very difficult for pupils to understand it without presenting pictures and playing a video about stars, planets, their movement and so on.'* (PST2 science)

Another issue raised by science pre-service teachers that they thought technology could contribute to solving was the risk in some scientific experiments. The third pre-service teacher (PST3 science) thought that visual modes of technology could 'replace' some dangerous experiments by presenting a video and some images that could show the pupils the experiment in all its details and process and avoid the risk of dealing with these experiments in person, such as some chemical experiments. He believed that PowerPoint slides containing videos and images were a good alternative to the live experiments.

> *'In physics for example, we teach physical phenomena that pupils cannot understand unless technology is used, such as videos or presenting specific pictures for the phenomena … also in chemistry, it is difficult some times to conduct some experiments in the lab due to the danger of some substances that are used, like some kinds of acids. In this case, the importance of technology increase where videos can be used showing all the experimental details and processes without putting the pupils at risk and so on.'* (PST3 science)

The lack of equipment required for science lessons was also mentioned by the same pre-service teacher (ST3 science) as an element that increased the value of technology in science as an appropriate solution. He argued that some topics in science needed to be presented with some tools and could not be presented as abstract concepts. Therefore, the visual mode of technology could cover this lack of tools by presenting these topics and their concepts as videos and images.

> *'There are many topics, which are presented in science lessons, that the pupils in primary school cannot understand through presenting abstract concepts by verbal explanation … you need to present them in a tangible way through pictures and video films. Also if the scientific labs are not available, technology could be a typical solution*

> *for presenting the lesson in a 'semi-practical' way through videos and pictures.'* (PST3 science)

It is apparent that science pre-service teachers sometimes had to replace traditional laboratory resources, such as models, samples and real experiments, with visual representations through technology. It seemed that science pre-service teachers believed that they had no choice in this replacement of non-technological with technological tools due to the risk of using some of them (real chemical experiments for example) and the shortage of others. This high dependence on technology did not exist in the case of the mathematics pre-service teachers, who depended more on non-technological tools and regarded technology as only an additional tool to their lessons.

6.2.3.2 The 'additional' function of technology in mathematics lessons

Unlike the science pre-service teachers, mathematics pre-service teachers still believe in the importance of the other non-technological tools such as drawing and counting tools that need to be used in mathematics lessons in addition to technology. A mathematics pre-service teacher (PST4 math) showed a strong belief that technology is important for mathematics to cover the lack of other non-technological tools such as drawing tools. This function of technology, according to this pre-service teacher, is consistent with his science colleagues' views that technology can replace unavailable non-technological tools that are needed for a lesson. He argued that he used visual modes of technology such as PowerPoint presentations to overcome the lack of drawing tools. This type of technology, he added, enabled him to present accurate visual objects such as shapes and drawing through presentation software. He also thought that using PowerPoint slides could save time and effort of drawing by hand and provide more interesting lesson for the pupils. This can be seen in the following quotes from his interview:

> *'I believe that technology saves time and effort, and help in organising lesson and its time through a number of presentation slides. In mathematics, we need to draw some shapes like triangles and squares … we have no tools to draw on the whiteboard, so, I can present accurate shapes and drawing through PowerPoint slides … this also saves time and effort, and present an interesting lesson for pupils' (PST4 math)*

The other mathematics pre-service teacher (PST5 math) who used technology in his teaching also agreed with his previous colleague about the importance of technology for mathematics teaching and learning.

> *'PowerPoint presentations is an important technology for mathematics as it could present concept in a clearer way … addition and subtraction operations … and so on, not like for example science where lesson should be in the lab through practical experiment' (PST5 math)*

Although the mathematics pre-service teachers showed a strong belief in the importance of visual modes of technology in mathematics teaching, they still believed more in the importance of non-technological tools. Therefore they seemed to be less dependent on technology than their science colleagues who seemed to see technology as an 'alternative' to non-technological tools. Mathematics pre-service teachers indicated that technology could be useful for mathematics teaching but needed to be combined with the non-technological tools that should not be replaced by technology. A mathematics pre-service teacher, who indicated a strong belief in the importance of technology for teaching mathematics, expressed the view that non-technological tools should not be replaced by technology as they are still very much needed in mathematics. He gave an example that the traditional whiteboard was a very important tool for mathematics lessons where exercises could be done step by step and the pupils could be engaged directly in the process. However, he indicated that using visual technological presentations could be interesting for pupils during the lesson but not as the main tool. This view can be seen in the following quote.

> *'Using technology in the classroom is important, but it is not enough to deliver the lesson without the practical side. With PowerPoint presentations, we should use for example the whiteboard for giving more examples and exercises and doing them step by step in front of the pupils. Presentations alone would limit you in a specific line for the lesson you have to follow … sometimes you need to give examples from outside the pupils' book and the presentation. I think using technology, such as PowerPoint presentations, is good if it is used with the other things like whiteboard and other traditional tools … not only technology. In this case the use of technology would be good. Because technology can be an element that draws the attention and interest of the pupils … this is an important feature.'* (PST5 math)

The same pre-service teacher (PST5 math) also went further and indicated that non-technological tools were much more important than technology for mathematics teaching. He thought that technology should not take a large part of the lesson, but the main tools for teaching should be the non-technological tools where pupils could practically engage and work with their hands and take more control over their own learning. He seemed to see technology as a tool that helped in making the lesson interesting by varying the tools used. These views can be seen in the following quotes from his interview.

> *'Technology should be used as an assistant element, especially in mathematics … technology could provide pupils with a ready peace of information and this is not very appropriate for mathematics … mathematics needs practical work for doing exercises … for example, when pupils learn units of weight, they should use the real scale by their hand … this is much better than showing them this experiment on the screen. […] The available technology is appropriate for mathematics, but as I said to you only as an assistant element with the traditional tangible tools.'* (PST5 math)

From the mathematics pre-service teachers' views, it can be argued that they tended to adopt more learner-centred instruction than their science colleagues who did not give their pupils control over their learning. This can be seen clearly when they addressed the importance of pupils using non-technological tools to learn deeply. On the other hand, science pre-service teachers tended to adopt visual modes of technology in teacher-centred lessons, with pupils sitting and watching visual illustrations of science topics.

From the above, it can be argued that the three science pre-service teachers who used technology regularly seemed to hold to traditional transmission pedagogy about teaching and learning. They seemed to adopt a teacher-centred strategy where teachers presented their work to passive receivers, as seen in the following field notes from the classroom observations.

> *'He used PowerPoint slides to present the lesson in a lecture style, providing some images. He also wrote some details on the whiteboard to support slides'* (Observation 1, PST1 science)
>
> *'He started introducing the concept of Energy through PowerPoint slides and explained the lesson traditionally. He used the empty spaces on the screen to write some comments'* (Observation 1, PST2 science)
>
> *'He started with an introduction using a slide containing a written text about chemical bonds, after that he continued with the slides explaining the content of each slide in a lecture style'* (Observation 2, PST3 science)

Therefore, they used technology to make the traditional lessons more interesting and draw the pupils' attention to the lesson. In other words, the emphasis in the case of science pre-service teachers who used technology in their teaching was on drawing the pupils' attention and fostering their interest in the lesson being delivered to them rather than taking an interactive role in their learning.

On the other hand, the two mathematics pre-service teachers in this study who used technology regularly seemed to see technology as only an additional part of the tools that should be used in any mathematics lesson. They seemed to believe that in order to provide a successful mathematics lesson, non-technological tools such as the whiteboard and other tools used by hand, for example for counting, needed to be used in addition to technology, where the non-technological tools played an important role in mathematics teaching and learning. They believed that these non-technological tools could improve the interactivity of the pupils and make their role more active during the lesson. The following field notes support this claim.

> *'He used the projector to present an introduction to the lesson showing the time units … He presented a slide containing 6 exercises for converting time units, and asked pupils to do them in their notebooks … Then he discussed their answers as a group. All the pupils were interested and keen to do the exercises and discuss their answers with their peers'* (Observation 1, PST4 math)

> *'At the beginning, he presented an introduction slide introducing the main idea of putting decimals into the graph giving several examples … he wrote a few exercises on the board and asked the pupils to put the decimals on the graph in their notebook, after that he showed them the right answers … he gave them the time to discuss their answers with each other. He checked their notebooks individually and checked their work.'* (Observation 3, PST5 math)

Unlike their science colleagues, mathematics pre-service teachers seemed to engage in a more learner-centred strategy where they allowed pupils to take control, at least to some extent, over their learning and to engage practically in the learning process. This engagement seemed to be more through the non-technological tools used by hand, to draw or count for example. A mathematics pre-service teacher (PST5 math) showed a pedagogical view that a practical aspect, where pupils engaged in activities using non-technological tools, was an essential part of any mathematics lesson.

> *'Using technology is important, but it does not deliver the lesson properly without the practical side. In addition to PowerPoint presentations, traditional whiteboard needs to be used for giving examples and exercises step by step with pupils … I think using presentations is good if accompanied with traditional tools.'* (PST5 math)

The following diagram (Figure 6.4) shows the different roles of technology in teaching and learning among the science and mathematics pre-service teachers.

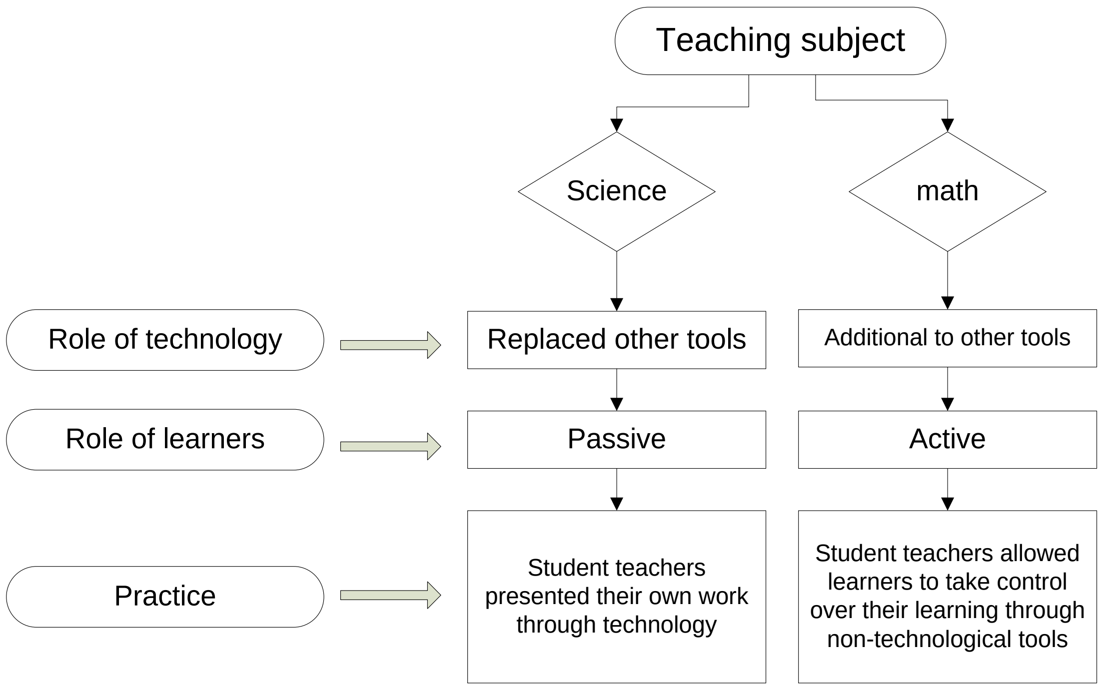


Figure 6.4: The difference in technology role between science and mathematics PST

6.2.4 Beliefs development settings: university study vs. teaching practice

In some cases, the participants already had a strong belief in the importance of technology and had previously planned to integrate it into their school placement teaching. For example, a pre-service teacher (PST4 math) seemed to have developed this strong belief about technology during his university study, which suggests the importance of university practice in forming the pre-service teachers' pedagogical beliefs.

> *'I have been already convinced of technology's importance before I came to school and I planned to use it if it is available.'* (PST4 mathematics)

However, one participant stated that engaging in teaching experience after he came to school had persuaded him of the importance of using technology in the classroom. This suggests that pre-service teachers might not believe in what they learned theoretically at university until they engaged in their teaching practice. Therefore, teaching practice at school might be seen as a 'learning', not only a 'training', setting for the pre-service teachers. For example, this pre-service teacher (PST3 science) argued that he recognised the importance of technology in education after he engaged in teaching experience at school.

> *'From my experience during the school placement here at school, I recognised that technology is very important in teaching in general and in science teaching in particular.'* (PST3 science)

However, the same pre-service teacher indicated that the school atmosphere did not encourage the use of technology. But the availability of technological equipment at school and the fact that learners liked learning with technology encouraged him to use it and, as a result, he believed in its importance.

> *'As I said to you, the general atmosphere in the school does not encourage the use of technology, but the availability of computers, projectors, and other technology equipment in the classroom, in addition to the desire of pupils to learn with technology, encouraged me to use it. I then recognised how it is important for teaching and learning.'* (PST3 science)

It was also noted during the classroom observation that he taught his three lessons in a classroom equipped with the technology that he needed (computer, projector and speakers). During the lessons, learners always showed strong interest when he used technology such as presenting images or video through PowerPoint slides. For example, in the third classroom observation, he was teaching the solar system and presented a short video about it where most of the learners asked him to play the video again and seemed to be very interested in it, as can be seen in the following field notes:

> *'He played a short video about the solar system; it was about five minutes produced by the BBC.*
>
> *After the video ended he discussed its content with the pupils.*

> *They were very interested in the video and asked him to play it again and he did.'* (Observation 3, PST3 science)

This strong interest in this type of technology seemed to be a reason behind his strong belief in the importance of technology which, in turn, informed his practice. Therefore, it might be argued that teaching experience was not only transferring theory into practice for this pre-service teacher, rather, he seemed to be 'learning' through practice.

In addition to the pre-service teachers who actually used technology in their teaching, it was also found that those who did not use technology at all also believed in its importance in education. The mathematics pre-service teacher who did not use technology but used non-technological tools such as whiteboard instead stated that technology had made a huge revolution in people's lives in all aspects including education. He argued that technology used in teaching is complementary to any curriculum and teachers cannot achieve lessons' aims properly without technology.

> *'Of course technology has made a radical change to our lives in all aspects … it makes life easier and saves effort and time … I believe in its important in education … it makes education more interesting for pupils, attracts their attention, and relieves boredom.'* (PST6 mathematics no tech)

This could suggest that this pre-service teacher had developed this belief theoretically during his university study; however, when he came to school, he did not seem to find the required tools or environment for integrating technology, as presented earlier in this chapter. Therefore, he kept to his earlier belief in technology but avoided adopting technology due to the lack of readiness at his practice school. The following diagram (Figure 6.5) shows the two paths of belief development among the pre-service teachers.

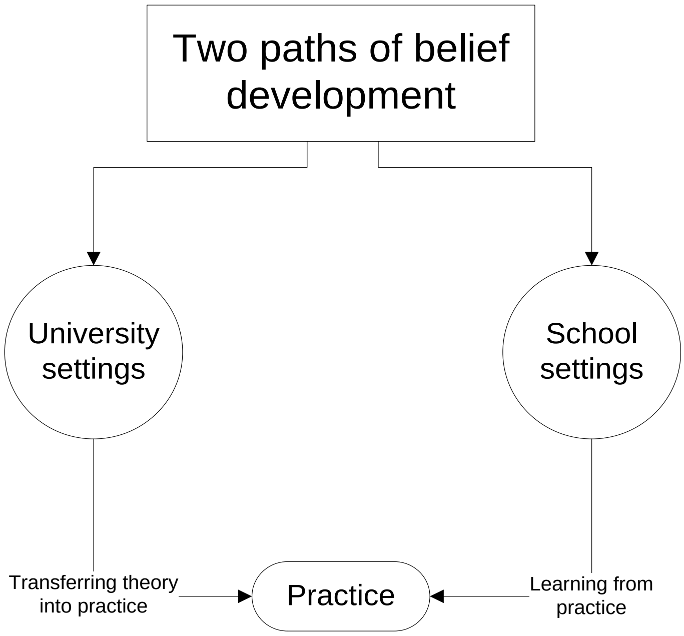


Figure 6.5: Belief development settings

6.2.5 Challenges face the pre-service teachers' adoption of technology

This section presents findings related to the challenges that affected the pre-service teachers' use of technology during their training. The data analysis revealed that there were several challenges reported by the pre-service teachers, including technical challenges, time challenges and personal challenges. These challenges are presented in detail below.

6.2.5.1 Technical challenges

Several technical issues were seen by the pre-service teachers to be challenges that limited or hindered their use of technology, both among those who used and those who did not use technology in the classroom. However, those who used technology seemed to overcome these challenges while those who did not use technology seemed to see these challenges as obstacles that they could not overcome.

Four out of the five pre-service teachers who used technology (PST1 science, PST2 science, PST3 science and PST5 math) reported that they faced technical issues that sometimes limited their use. However all of them reported that they always sought help and tried to solve these issues. This could be because they were convinced they should use it and believed in its importance, as presented in the first section of this chapter. For example, the first pre-service teacher (PST1 science) said that computer breakdown due to a virus or other problem sometimes limited his use of technology in the classroom. He argued that, due to this kind of technical problem, he sometimes postponed the lesson until the problem was solved.

> *'… like a breakdown in the computer due to a virus or other reason, this type of problem makes me postpone the lesson.'* (PST1 science)

It seems that this pre-service teacher's strong belief in the importance of technology encouraged him to find solutions to the technical issues that faced him. He explained that when he faced such problems he postponed the lesson until he had dealt with it by seeking help from more experienced teachers. However, the alternative plan, when the technical issue was not solved, was to teach without technology using the traditional whiteboard.

> *'I postpone the lesson until the problem is solved, usually I ask for help from my colleague who is well-skilled in technology.'* (PST1 science)
>
> *'Teachers … some of them helped me in solving technical problems.'* (PST1 science)
>
> *'Some devices in classrooms are not good. In this case I try to find an alternative such as teaching traditionally through the whiteboard.'* (PST1 science)

Although this pre-service teacher seemed to solve his own problems by seeking help, he seemed to be too dependent on technology in his teaching to the extent that it affected the teaching and learning process when technical problems occurred.

The other pre-service teacher (PST2 science) also reported the breakdown of devices as a technical issue that sometimes limited his use of technology. However, this pre-service teacher seemed to be more independent as he overcame this challenge during the lesson and did not allow it to interrupt the lesson. He reported that when he faced computer problems he always found instant solutions, such as connecting his mobile phone with the projector to continue teaching. As noticed during the classroom observations, this pre-service teacher showed a high level of technological skill compared with his colleagues. This helped him to solve technical problems easily.

> *'Sometimes the device's breakdown constitutes an obstacle … I usually use computer and projector, once, I used my mobile phone because the computer was not connected to the internet, I displayed a video about the solar system through connecting my mobile phone with the projector, it was a good experience at the beginning of my training.'* (PST2 science)

The third pre-service teacher (ST3 science) also stated that device breakdown was an obstacle to using technology. Similar to his previous colleague, he explained that he attempted to solve these technical issues himself as they were usually minor problems such as cable connections.

> *'For example, device breakdown, it is a problem especially when there is no professional support at school. This limits the use of technology.'* (PST3 science)
>
> *'I solve it if I can. Usually they are minor issue that I solve myself such as sound problems or cable connections.'* (PST3 science)

Another technical challenge that was reported by a mathematics pre-service teacher (PST5 math) was the difficulty of operating some types of technology. This issue was faced by this pre-service teacher who seemed to be less skilled in technology as noticed during the classroom observations. However, his belief about the importance of technology use in the classroom seemed to encourage him to overcome this problem by seeking help from the cooperating teacher, who was very supportive in this pre-service teacher's case.

> *'Sometimes I face some difficulties such as operating software … sometimes there are some complexities in the computer or the projector or the software itself … I ask someone who is expert, usually the cooperating teacher… my experience is small to some extent in dealing with such technology.'* (PST5 math)

6.2.5.2 Time challenges

Two of the seven pre-service teachers interviewed (PST2 science and PST7 science no tech) reported that challenges related to time faced them when they used technology. While these challenges did not prevent the first one (PST2 science) from using technology, they did seem to prevent the second one (PST7 science no tech). This could again be due to their beliefs about the importance of technology in education which were strong for the first one but weak for the other.

Preparation for using technology in a lesson was seen by the first science pre-service teacher (PST2 science) as a time challenge, especially when he was busy or engaged with other tasks. This was because preparing technology to be used in a lesson was time-consuming. He indicated, however, that he used technology in most lessons but he used non-technological tools when he did not have time to prepare the technology or when he was busy with other tasks.

> *'Sometimes I am tired or busy to the extent that I cannot prepare a presentation or software to teach with, in this case I teach traditionally with non-technological tools. You know, using technology needs preparation, you need time and reading more in the subject.'* (PST2 science)

> *'When I have some problems or I'm busy I do not like using technology … this is a problem.'* (PST2 science)

The use of technology such as PowerPoint during a lesson was seen as significantly challenging regarding the lesson time by the science pre-service teacher (PST7 science no tech) who did not use technology in his teaching. This issue might have prevented him from using technology as he showed a relatively negative attitude towards using technology in primary school, as presented earlier in this chapter. He indicated that the lesson time (45 minutes) was too short to integrate technology into teaching; he thought that the time spent in preparing and operating technology could affect the discussion time with the pupils. In addition, he argued that using technology would make pupils' attention go to the technology itself and take it away from the lesson. However, and as discussed earlier, this pre-service teacher seemed to be weak to some extent in pedagogical aspects which could have led to his weak lesson management.

> *'Of course technology facilitates many things in education, but it has disadvantages such as consuming the lesson time. The lesson is 45 minutes, if I take time to prepare devices and operating them, it won't be enough for the lesson, discussion and answering the pupils questions.'* (PST7 science no tech)
>
> *'Using technology would make me behind the lesson timeline and make the pupils busy with things away from the lesson. Personally I did not like this way, writing on the whiteboard and direct communication with the pupils are better for me and them.'* (PST7 science no tech)

In the same regard, one of the head teachers (HT1) also raised the issue of time when using technology in the classroom. He argued that the long curriculum in primary school did not allow teachers to use technology and take advantage of its various affordances. He indicated that if teachers wanted to use technology properly with the too long curriculum, they would definitely be behind the timeline of the term. This could partly explain the reason behind the lack of support or encouragement for using technology by school management as they seemed to aim just to complete the curriculum regardless of teaching method. In addition, this head teacher raised the problem of teachers' full timetables (24 lessons weekly) which put teachers in a rush and did not allow them to prepare and use technology, apart from limited use of PowerPoint presentations, according to his point of view.

> *'Curriculum is too long … and teachers are asked to use technology, I think time in this case does not allow them to use it, otherwise they would be behind the time plan … this prevented teachers from using technology apart from PowerPoint presentations.'* (HT1)

> *'Curriculum in primary school is very intensive which limits the use of technology more widely. Teachers borrow more lessons just to complete the curriculum.'* (HT1)

> *'How we give teachers twenty four lessons a week and ask them to be creative? With the long curriculum, there will be no creativity in using technology and in teaching in general.'* (HT1)

6.2.5.3 Personal challenges

In addition to the technical and time challenges facing the pre-service teachers when using technology, two of those who used technology (PST2 science and PST3 science) reported some personal challenges that affected their use of technology. However, they indicated that they usually overcame these challenges as they both believed in the importance of technology's role in education, as presented earlier in this chapter. The first personal challenge reported by a science pre-service teacher (PST3 science) was his low level of English language which limited his ability to access many resources in the internet, which is mostly in English, to prepare his lessons. However, he could overcome this challenge by seeking help from a member of his family (brother) whose English was better. This help included searching for information he needed for his lessons and searching for videos related to the lessons that might be available on English websites.

> *'My English is not good, but my brother helps me a lot. Because his English is very good he helps me in searching for information that I need for my lessons and searching for videos related to some*

> *lessons that might be available more in English websites.'* (PST3 science)

The other science pre-service teacher reported another personal challenge that sometimes faced him when using technology, which is his 'mood'. He stated that, as using technology needed preparation, he sometimes felt that he was not in the mood to do so. In this case, he asserted that he used non-technological tools. However, if this was the case with a difficult lesson, he postponed difficult concepts to be taught later in another lesson when he was able to prepare technological tools that could help in teaching these difficult concepts.

> *'Sometimes my mood was an obstacle to using technology … if I have problems or I am busy, I do not like using technology.'* (PST2 science)

> *'If I have a problem preventing me from preparing technology properly, I teach traditionally with non-technological tools. If there are some difficult or complicated points in the lesson, I postpone them to a coming lesson when I am able to prepare presentations, images or videos.'* (PST2 science)

The following diagram (Figure 6.6) summarises the challenges reported by the participants and the solutions they adopted to overcome these challenges.

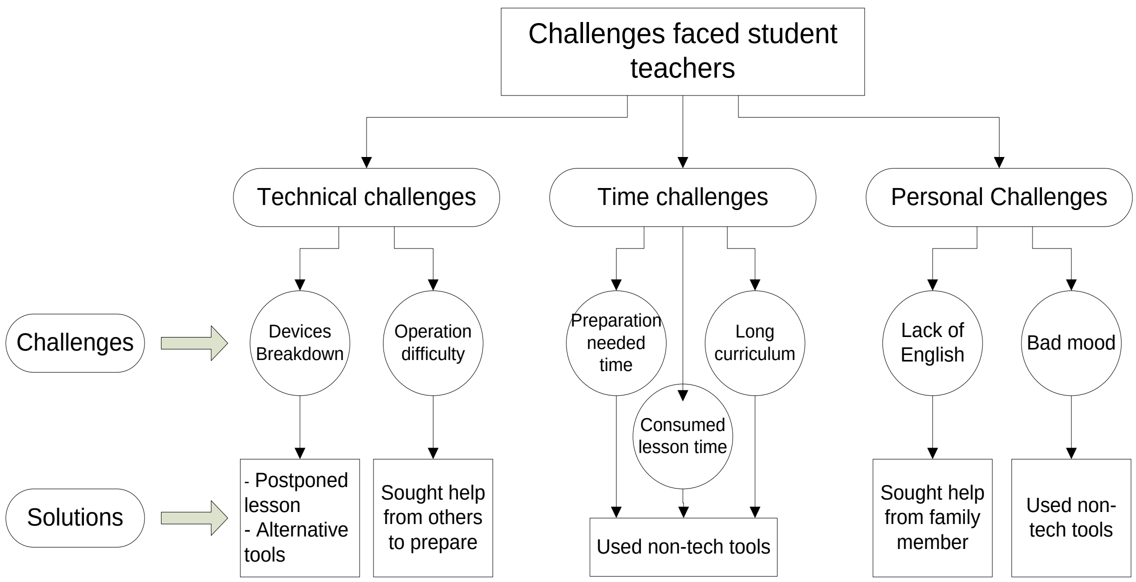


Figure 6.6: Challenges facing the student teachers when using technology

6.3 The pre-service teachers' experience with technology

This section presents the findings related to the pre-service teachers' experience with technology, including both their experience with using technology during their university study and their personal experience with technology in their lives.

6.3.1 Technology use by the pre-service teachers during university study

The analysis of interview data revealed that most of the pre-service teachers' experience with technology during their university study was for self-study. Three of the seven pre-service teachers (PST1 science, PST2 science, PST6 math no tech) indicated that they used technology such as searching databases, discussion forums, and using editing software to support their university study. One pre-service teacher (PST1 science) explained that he, at least, used databases to download materials that could help him in his assignments.

> *'During my university study, I used databases to find materials that support my work in the assignment.'* (PST1 science)

Technology also played a more important role in some other pre-service teachers' study. For example, another pre-service teacher (PST2 science) noted that, when he was at university, technology, particularly the internet, was an essential tool that supported his study for assignments and self-study through discussion forums and websites related to his subject. He also indicated that he always helped his colleagues who were not good enough in technology to find references and materials on the web. This pre-service teacher showed a strong relationship with technology, as can be seen in the following quote.

> *'At the university I became dependent on the internet significantly for my study … you know … for research and assignment purposes, and other related websites. I used to help my colleagues who are not good in using technology to find materials and websites that they need … I have a strong connection with technology.'* (PST2 science)

These findings showed consistency between the use of technology during university study and the use of technology during teaching practice among those who actually adopted technology in their lessons. However, one of those who did not use technology in his teaching also said that he had depended on technology previously at university, to some extent, for many educational purposes. The mathematics pre-service teacher (PST6 math no tech) who did not use technology at all in teaching indicated that he was dependent on technology to some extent for many purposes such as searching for materials, watching recorded lessons, finding references and so on. However, he raised an important point that there was no support provided by the university to take advantage of these types of technology and his use of technology was through external websites not related to the university. This finding shows inconsistency between this pre-service teacher's use of technology during university study and during teaching practice where he did not use technology in teaching.

'I, as a student, got many benefits from the internet during my university study. I search for supporting materials, find lessons as videos in the web, many things that support my study … all these things from resources not related to the university … unfortunately the university did not help in this matter … all by personal effort.' (PST6 math no tech)

From the quote above, this pre-service teacher always expected more official support, both to use technology during the university study and during teaching practice, as he always blamed the two institutions for the lack of support and preparation to use technology.

On the other hand, the science pre-service teacher who did not use technology in his teaching (PST7 science no tech) showed a consistent trend with his views about the value of technology in teaching during teaching practice at school. As shown previously, this pre-service teacher did not seem to believe in the importance of technology for teaching and learning. He indicated that he did not use technology for any educational purposes during his university study but his use was limited to personal and social purposes. This belief about technology could have hindered his use of technology for both university study and teaching at school.

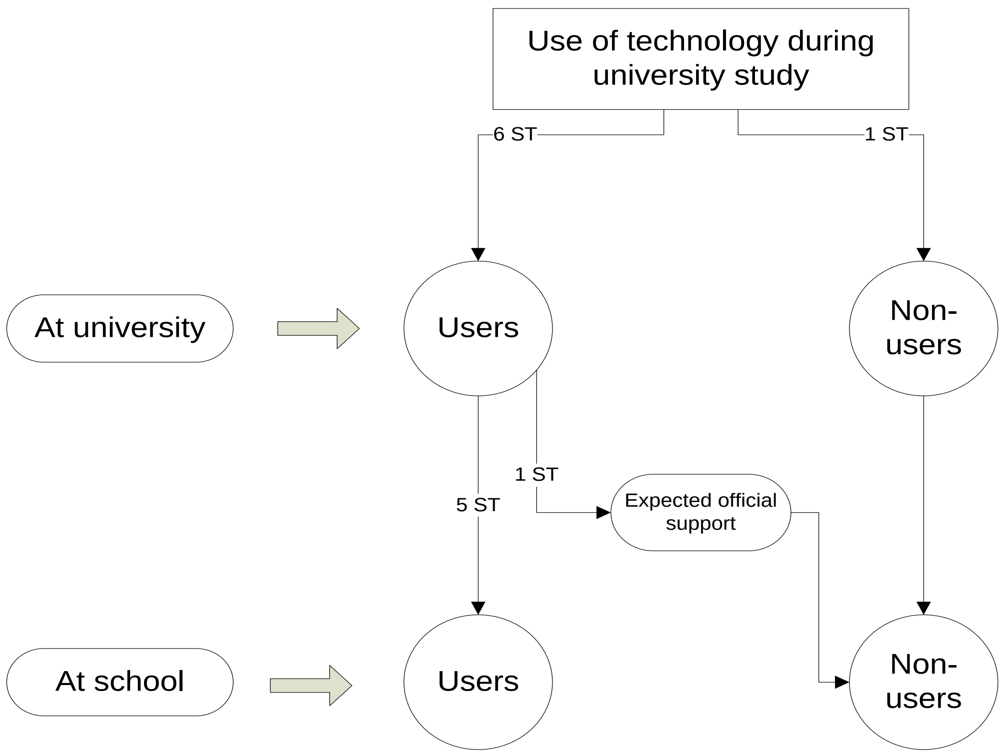
'Indeed, I did not get any benefits from technology for educational purposes. I used it for something else not related to education, but for education, no. I only used books in a traditional way … without technology.' (PST7 science no tech)

'Even in my university study, I did not get any benefits from technology except very basic things like typing assignments in Microsoft Word and printing. Actually some of our lecturers used PowerPoint presentations and they were good. But I do not think it would be beneficial for primary school pupils.' (PST7 science no tech)

From the above quote, although this pre-service teacher saw PowerPoint presentations as a useful tool at university, he argued that it would not be as beneficial for primary school pupils. As explained earlier in this chapter, this pre-service teacher did not use technology due to his view that technology would affect the classroom management negatively and pupils would not take the lesson seriously. This could be due to his lack of pedagogical knowledge and the way he dealt with pupils during the lesson.

In short, the use of technology by the pre-service teachers during their university study can be university study can be seen as an indicator for their adoption of technology during teaching during teaching practice except for the mathematics pre-service teacher (PST6 math no tech) math no tech) who used technology for university study but not for teaching due to his high to his high expectations of official support before he used it. This suggests that those who used those who used technology for their study were more likely to adopt it in their teaching later. teaching later. This might be linked to their beliefs about the value of technology itself for itself for education in general as presented in the previous section of this chapter. The following chapter. The following diagram (ST = Student Teachers

Figure 6.7) summarises these findings related to the consistency and inconsistency between the use of technology during university study and teaching practice.



ST = Student Teachers

Figure 6.7: Consistency and inconsistency between the use of technology during university study and teaching practice

6.3.2 The pre-service teachers' personal experience with technology

The pre-service teachers, especially those who showed regular use of technology in their teaching, seemed to adopt technology significantly for personal purposes such as social communication, web surfing, shopping, gaming and many other purposes. All the five pre-service teachers who used technology in their teaching and believed in its importance in education indicated an intensive use of technology and a strong connection with it for personal purposes. A pre-service teacher (PST2 science) showed a strong relation with technology where it played a vital role from an early stage in his life for many purposes such as web surfing, video games, chatting with people. He explained that he was dependent on technology all the time and learned advanced functions such as programming through engaging in professional technical forums. He also showed high dependence on technology during his university study. This experience seemed to play an important role in forming his views about the value of technology for all life's aspects, including education.

> *'I have used technology since I was 13 or 14, I used to surf websites, play video games, use software and programming and chatting websites … My relation with internet was so strong and I used to spend so long time on it ... I read and learned about it through engaging in a professional websites. At the university, I was more dependent on technology for educational purposes, research and so on. I used to help my colleagues in things related to technology.'* (PST2 science)

The other four pre-service teachers who used technology regularly in their teaching also described technology as an important part of their lives for the same personal purposes stated earlier. They all indicated a strong relation with technology for social communication, web surfing, reading news and other personal purposes. The following quotes are examples from their interviews.

> *'I use my computer regularly to access the internet for web surfing, newspapers, forums and so on … Also I use my mobile phone to access the internet.'* (PST1 science)

> *'Technology is everything in my life, I do everything through it … surfing the internet, forums, news websites, research and studies, communicating friend and colleagues, using email and Twitter all the day. I spend 85% of my time using these different types of technology.'* (PST5 math)

In addition to those who used technology regularly in their teaching, the two pre-service teachers (PST6 math no tech, PST7 science no tech) who did not use technology in their teaching also showed that they used it for personal purposes and described it as an important part of their daily lives. The mathematics pre-service teacher (PST6 math no tech) indicated that he had used technology on a daily basis for a long time and he accessed the internet daily for many purposes. He also described himself as a skilled user of technology.

'Technically, I know how to use available technology, basically, it is very easy to use.' (PST6 math no tech)

'I have used technology for so long and I like computers. I use computer for almost everything, my vision has been badly affected because of that. I have accounts in many websites that I visit regularly. I got many benefits from the internet that facilitated many things in my life. Computer and internet are very important parts of my daily life.' (PST6 math no tech)

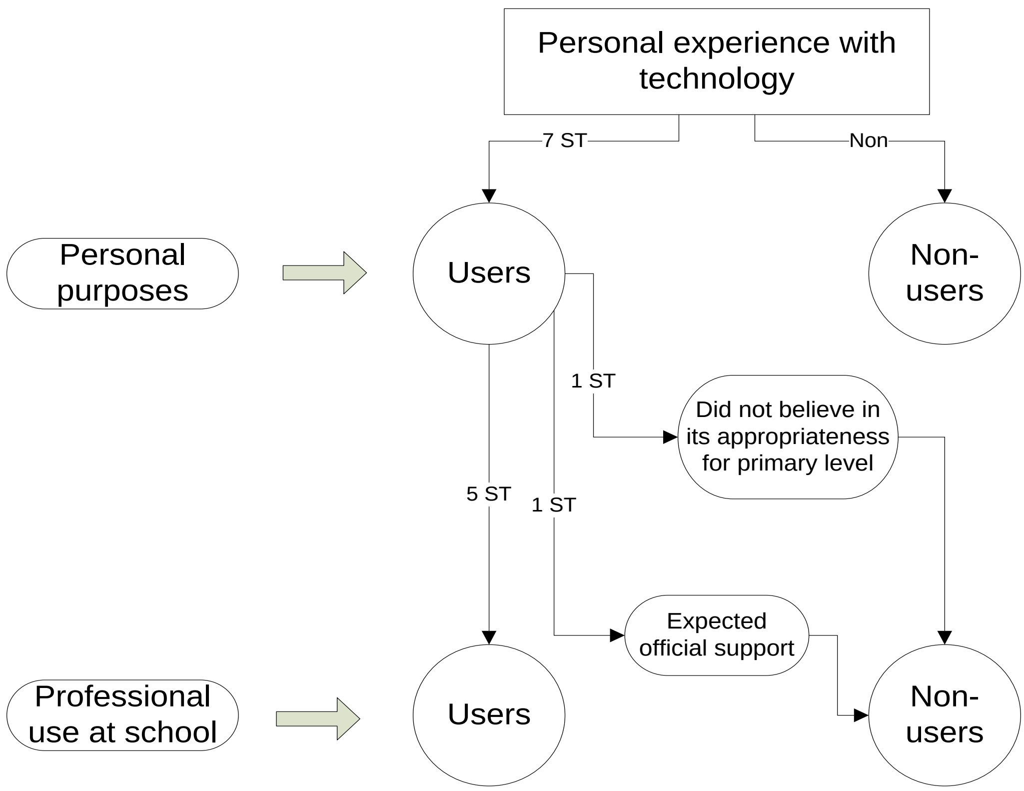
However, rather than his technological experience, there seemed to be other factors that hindered him from using technology in the classroom related to his pedagogical views about how technology should be integrated into education and related to the current school setting. As explained in the previous section in this chapter, he expected more official support and preparation in order to integrate interactive types of technology.

The other pre-service teacher who did not use technology in his teaching (PST7 science no tech) also showed a strong relation with technology for personal and social purposes.

'I use technology widely in a daily base for many purposes such as web surfing, news, booking appointments, paying bills … many other things in my life done through the internet. I have Facebook and Skype accounts; I use it a lot for social communication. All these types of technology became very important to me. Also, the new smart phones facilitated these things more … now I do all these things through my mobile phone from everywhere.' (PST7 science no tech)

However, and as shown earlier in this chapter, he did not use technology in teaching due to his view about the low value of technology with primary school pupils who do not take the lesson seriously when technology is used but were more interested in the technology itself. These findings suggest that the pre-service teachers' personal experience with technology has no obvious influence on their use of technology in teaching or on their beliefs about its value for education, particularly at primary school level. These findings are summarised in the following in the following diagram (ST = Student Teachers

Figure 6.8) below.



ST = Student Teachers

Figure 6.8: Personal experience with technology and professional use at school

6.4 Summary of the chapter

In this chapter, I have presented the first part of the qualitative findings from the interviews and classroom observations. I presented findings related to the pre-service teachers' perceptions of using ICT in the classroom including their views on the importance of technology use in the classroom. I also presented the participants' perceptions of the role of technology in teaching and learning from two different angles: users of technology vs. non-users, and science vs. mathematics. Also, findings related to the pre-service teachers' beliefs development settings were presented, followed by challenges facing pre-service teachers when using technology. The second part of this chapter presented findings related to the pre-service teachers' experience with technology, including technology use during university study and the pre-service teachers' personal experience with technology.

7 Qualitative Findings (part 2)

7.1 Introduction

This chapter presents findings related to the influence of the university and school settings on the pre-service teachers' use of technology in the classroom. Through this part, I present various elements within the practice settings: school, university, and the partnership between them, that the participants reported to be important factors influencing their perceptions and practices related to the integration of technology in the classroom. I also present findings from those who did not use technology and the influence of the practice settings on their decisions.

7.2 Influence of school settings on pre-service teachers' use of technology

The school settings seem to play a vital role in the pre-service teachers' decision to either use or not to use technology. Many factors were reported by the participants that influenced and shaped thier use of technology in the classroom including social factors (e.g. relationships with others), technical factors (e.g. technical support and training), and pedagogical factors (e.g. motivations to use specific strategies) in addition to other factors reported below in more detail.

7.2.1 Availability of technological equipment

All the pre-service teachers who used technology regularly in their teaching (three science and two mathematics) indicated that the school atmosphere in general encouraged them to adopt technology in their teaching. The first element that was seen by the pre-service teachers to be an encouraging element was the availability of the necessary technological equipment and resources in the school and in the classrooms.

All the five pre-service teachers who used technology stated that the school atmosphere has encouraged them to use technology. They highlighted the availability of technology equipment as an important element in the school setting that contributed to their decision to adopt technology in their teaching. For example, two of them (PST1 science and PST4 math) always mentioned 'school atmosphere' in general as a supportive element that made them use technology in addition to the personal views about technology presented earlier in this chapter.

> *'The school atmosphere in general supports and requires the use of technology in education.'* (PST1 science)
>
> *'The school atmosphere encourages the use of technology in education more than the university does.'* (PST4 math)

As mentioned earlier, the availability of technological equipment seemed to play an important role in forming this view about the school atmosphere as they saw the provision of technology as an encouraging element in the school setting. Some examples of the pre-service teachers' statements regarding this issue are listed below.

> *'Technology is available to some extent, what I need for teaching science is a computer and a data show projector, this is available in all classrooms … this helped me to use technology.'* (PST2 science)
>
> *'School has a positive influence on my technology use in the classroom, firstly, classrooms are equipped with technologies I need, also the cooperating teacher helped and supported me in technology use and gave me software I need.'* (PST4 math)
>
> *'Devices are available in the math lab and most of the classrooms … cooperating teacher helps me and trained me how to use technology … classrooms contain visualiser devices easy to use … so, I think the school atmosphere encourages the use of technology.'* (PST5 math)

In addition to the pre-service teachers, one university tutor (UT4) stated that the school setting and atmosphere encouraged the pre-service teachers to adopt it. He believed that when the school adopts technology integration into practice, and when they depend on technology to the degree that there is a lack in the other non-technological tools, then the pre-service teachers are encouraged to use it to cope with the general approach of the school.

> *‘The reality in schools encourages them, I mean, when they go to school, and the face a lack of non-technological tools, they have to use learning resources centre, computers, projectors, internet … this is imposed to the reality of the school setting.’* (UT4)

7.2.2 Pupils’ interest in technology

In addition to the availability of technological equipment, the five pre-service teachers who used technology reported that the pupils’ interest in technology was another element that encouraged their adoption of technology. They seem to see pupils as an important component of the school setting that significantly influenced their choices when planning for lessons. Therefore, they all reported that, by the fact that pupils were interested in technology, they were encouraged to use it in their teaching. The following quotes are some examples of this view.

> *‘Most important is the pupils’ interest. They want to learn through lessons presented as PowerPoint presentations, video, images, this what made me keen to use technology all the time … the school atmosphere in general supports and requires the use of technology in education.’* (PST1 science)

> *‘Pupils feel more comfortable when I use such technology … they concentrate more on the lesson and become more active … therefore, I think it should be use constantly in all lessons.’* (PST4 math)

> *‘The pupils also like technology, so as I said to you, the school atmosphere encourages the use of technology.’* (PST5 math)

7.2.3 Relationships with others at school

The relationships with others within the school setting were also reported by three pre-service teachers (PST1 science, PST4 math and PST5 math) to be an element that encouraged them to use technology in the classroom. Other teachers at school seem to play an important role in the decision of adopting technology when they provide the advice and support needed by the pre-service teachers. The science pre-service teacher (ST1 science) stated that because there were teachers who used technology and talked about its advantages, he felt encouraged and confident to use such technology in his teaching.

> *'There are teachers and student teachers who use technology and talk about its advantages … this also made me keen and enthusiastic to use it in teaching.'* (PST1 science)

He added that some teachers and one of the pre-service teachers helped him and trained him in how to connect devices and operate them. Also some teachers helped him in solving technical problems when operating these technologies.

> *'There are some teachers at school who helped me and trained me about the way I connect and use devices, such as mathematics teachers and Arabic language teachers.'* (PST1 science*)*

> *'Many of them provided me with information about the use of technology, and some of them helped me in solving technical problems.'* (PST1 science)

> *'I got benefits from those who use technology either with regard to the way I use it or in solving problems I face.'* (PST1 science)

The other two pre-service teachers (PST4 math and PST5 math) also highlighted the importance of the relationships with teachers at school as an effective element that fostered their use of technology in the school setting. Both of them stated that the school teachers advised them to use technology in teaching and benefit from its advantages. For example, one of them (PST5 math) reported that some teachers encouraged him to use technology and others trained him in how to use technology.

> *'Teachers at school always advise me to use available technology to teach in a better way.'* (PST5 math)
>
> *'Year one teacher trained me how to use the visualiser to use it when teaching year one.'* (PST5 math)

The other mathematics pre-service teacher (PST4 math) also emphasised the important role of the relationship with other teachers in encouraging him to use technology, especially the cooperating teacher who taught the same subject, mathematics. This pre-service teacher admitted that if the cooperating teacher had not used technology, he would not have used it himself in teaching. This indicates the importance of the relationships with other teachers at school in forming the pre-service teachers' ideas about teaching and learning.

> *'At the beginning of the training, there was some encouragement from teachers to use technology in the classroom, especially the cooperating teacher, the mathematics teacher at school.'* (PST4 math)
>
> *'I think if he did not use technology I would not use it myself.'* (PST4 math)

The relationships with other pre-service teachers at school seemed to play even more important role in the adoption of technology by the science pre-service teacher (PST1 science). He indicated that his colleagues, especially the one teaching science, trained him and helped him in solving technical problems such as device breakdown, and also designed some lessons for him as PowerPoint presentations. Therefore, this colleague seemed to significantly encourage this pre-service teacher to use technology.

> *'Student teachers at school are enthusiastic for using technology in teaching, some of them are skilled in technology, help the others to find software and lessons, and share it with the others. Personally, I got benefits from them, I had software from them to use in my*

> *lessons … to be honest, they had the biggest role in my constant use of technology in the classroom.’* (PST1 science)

> *‘My colleague, who is with me in the same subject, was the most important supporter in my technology use … he is very well-skilled in technology. He explains to me how to connect devices, operate software and he solves technical problems facing me such as computer or projector breakdown … sometimes he designed PowerPoint presentations for me.’* (PST1 science)

On the other hand, another science pre-service teacher (PST3 science) had limited relationships with the others at school, whom he said did not have any influence on his teaching strategy, including the use of technology. However, and as presented earlier in this chapter, this pre-service teacher adopted technology because he was convinced of its value in education.

> *‘There is no influence of the others on my decision to use technology, my relationship with them is very limited.’* (PST3 science)

The above findings raise the issue of pre-service teachers’ identity formation within the school setting during practice, which is significantly influenced by their relationships with the others, and which should therefore be given more attention by the training organisers and educators. In this regard, one of the university tutors highlighted this issue stating that many pre-service teachers gain experience from their former or current colleagues. According to this university tutor, this means of gaining experience and ideas about teaching and learning was preferred by the pre-service teachers over reading the guidelines and manuals provided by the university. Pre-service teachers seemed to think these resources were part of routine processes, or more theoretical, and that they did not need to consider them in practice. Therefore, pre-service teachers tend to prefer to gain experience and improve their teaching through their relationships with others in the school setting.

> *‘Because of a common culture among the student teachers, most of them gain experience from a former colleague, they do not seem to consider guidelines or follow them. They think these guidelines are*

> *similar to many guidelines they receive during their university study, which give a general kind of recommendations and are not compulsory to follow or kind of routine.*' (UT2)

In contrast, the pre-service teachers raised some issues in the school settings that seemed to be discouraging elements of using technology within the school. However, those who used technology in their teaching had overcome these issues by themselves while those who did not use technology were more affected by these issues.

One of the science pre-service teachers (PST2 science) who used technology indicated that, when he came to the school at the beginning of the term, the use of technology was not a common culture and the general teaching style at school was the traditional transmission strategy of teaching with non-technological tools. This school culture presented a challenge that this pre-service teacher overcame because of his belief in the importance of using technology in education.

> *'At the beginning, the teaching style at school was more traditional without technology, they even did not expect me to use technology in my teaching, but I used it because I believe in its importance for teaching.'* (PST2 science)

Another science pre-service teacher (PST3 science) who used technology also saw the lack of school expectation for using technology as a negative element at school; however, he recognised other elements in the school setting to be encouraging elements that convinced him to use it, such as the availability of equipment and the pupils' interest in technology.

> *'I think the school does not encourage the use of technology in the classroom, not from the head teachers, not the teachers, nobody expects me to use it or discusses that with me …. But the availability of devices in most of the classrooms and the pupils' interest in learning with presentations and technology in general were encouraging elements for using technology.'* (PST3 science)

However, these two pre-service teachers (PST2 science and PST3 science) had previously shown limited relationships with the others in the school setting, which could raise the issue of this kind of relationship in the pre-service teachers' views about teaching and learning. This contrasts with the other three pre-service teachers (PST1 science, PST4 math and PST5 math) who saw the school setting as having a more encouraging atmosphere for the use of technology, possibly, as a result of their social relationships with the others.

Regarding the pre-service teachers who did not use technology in their teaching, the school atmosphere seemed to be an obstacle that prevented them from using technology, especially for the mathematics pre-service teacher (PST6 math no tech). However, and as presented earlier in this chapter, this pre-service teacher indicated that the availability of computers in the classroom was not sufficient to integrate technology into teaching. It was shown previously that he thought that technology integration needed a whole interactive system that needed preparation, training and more advanced technology.

> *'The school did not give any attention to the use of technology in education … if the culture of technology use and its importance was not spread among people at school there won't be effective use.'* (PST6 math no tech)

7.2.4 School building as an influential element

Another issue, raised by two university tutors, which was seen as an obstacle to using technology in the school setting, was the type of school building. As some schools rent buildings that were designed for other uses, some of these buildings did not allow the pre-service teachers to use technology due to the lack of equipment and the small size of classrooms that are sometimes too small to include technological equipment. For example, the first university tutor thought that some pre-service teachers practised in rented schools where classrooms were too small and crowded which made it impossible to include technological equipment.

> *'Some trainees take their training in rented schools, which are unfortunately very crowded, with a lack of technological equipment in the classroom, in this case the trainee cannot integrate technology because the environment is not suitable for this type of tools.'* (UT1)

The third university tutor (UT3) also highlighted this issue as an obstacle to using technology encountered by some pre-service teachers. He saw this issue as a major reason behind some pre-service teachers' lack of technology use.

> *'There are some schools which have rented buildings, unsuitable buildings … this causes the student teachers not to use technology.'* (UT3)

The issue of the school buildings was noticed when I was preparing for data collection as I visited three rented schools and all the pre-service teachers I met stated that they did not use technology because it was not available. They therefore refused to participate in the study for the interviews or observations.

7.2.5 Lack of training and support

Moreover, lack of technical training and support was widely reported by the participants to be an issue in the school setting. Although the four head teachers stated that there was a specialist in the learning resources centre in most of the schools who was responsible for training and support at school, this did not seem to happen in reality. The following quotes are only examples from the head teachers' interviews.

> *'The resources specialist is actually the person who helps the student teachers if they want to use technology.'* (HT1)

> *'The specialist of the learning resource centre and the computer teacher could help anyone needs help and train him to use any software.'* (HT2)

All the seven pre-service teachers interviewed in this study complained that they did not receive enough help or support from the school when using technology. Those who used technology indicated that they trained themselves independently of the school. The following quotes are some examples of their statements.

> *'I trained myself by myself, with some help of my colleagues and some teachers, I got experience by myself.'* (PST1 science)
>
> *'There is no such type of training or support; I do not need it by the way.'* (PST2 science)
>
> *'No, there is no training for technology use … the trainee improves himself independently.'* (PST3 science)
>
> *'Actually, there is no good equipment, no good preparation for teachers … how can I use it in this case?'* (PST6 math no tech)

However, only one of them (PST5 math) has received real training and help from the cooperating teacher. As noticed during the classroom observation, this pre-service teacher showed limited knowledge in using technology, but he was well-organised and presented his lessons with an effective integration of technology. In addition, he admitted that the cooperating teacher had significantly influenced his practice and his support was a reason behind his adoption of technology, as presented earlier in this chapter. This highlights the importance of the cooperating teacher in forming the pre-service teachers' pedagogical identity.

> *'There is no official training … the cooperating teacher trained me on how to use it and always help me, this is everything.'* (PST5 math)

7.2.6 School expectations for the use of technology

This section presents findings related to the expectations of the schools for the pre-service teachers' use of technology in the classroom in light of the standards of the education authority and university. The need for exploring these expectations emerged due to the lack of written policies related to technology in the official documents of both these organisations. When I reviewed their guidelines and assessment forms, they only mentioned the use of tools and instructional means in general and there was no specific mention of technology use. Therefore, the need for exploring this issue from all the stakeholders' (pre-service teachers, university tutors, and head teachers) perspectives became a crucial part of this study.

The analysis of the interview data revealed that there was a conflict between what head teachers or 'school' expected from the pre-service teachers regarding technology use and what the pre-service teachers thought were the school's expectations. This conflict was very clear as head teachers always expressed their high expectations of the pre-service teachers' technology use while the pre-service teachers indicated that the schools did not show any expectation or encouragement for integrating technology into their teaching practice. This is illustrated in more detail later in this section.

One of the four head teachers interviewed (HT1) showed a high expectation from the pre-service teachers in his school to use technology in their teaching as it would facilitate their jobs and save their time and effort, according to his point of view. However, it seems that there was no clear strategy in his mind about how the pre-service teachers should use it. Rather, he seemed to expect them to use it only because there were some types of technology available in the classroom that should be used regardless of the teaching strategy.

> *'Technology is available in our school, like other schools in the area, and we expect the pre-service teachers to use as it facilitates their job and saves their time and effort, saves the lesson time … we expect them to use technology.'* (HT1)

Unfortunately, this head teacher's high expectations of technology use by the pre-service teachers were disappointed. He blamed the university for not being concerned about the pre-service teachers' use of technology, either during their study or their teaching practice, resulting in pre-service teachers' lack of relevant skills. This complaint could explain the gap between the school expectations and what happened in actual practice. This head teacher deplored the gap between the university programme and the reality in schools. This issue will be discussed in a separate section later in this chapter.

> *'So, I think we expect them to use technological tools available at school but the university did not show any concern about this issue, neither in their study programme nor in their pre-service teachers supervision during training.'* (HT1)

Another head teacher (HT2) also showed high expectation for the pre-service teachers' use of technology in the classroom and expressed its importance for education. However, and similar to the previous head teacher's view, he seemed to focus on technological aspects and not pedagogical strategies of using technology, as he showed high expectations for pre-service teachers' use of technology in general only because some equipment was available in the classroom. He also seemed to see technology as a tool that could support the traditional transmission strategy of teaching as he thought that the presence of a data show projector in the classroom was a good reason for the teacher to integrate technology into their teaching.

> *'It is necessary that pre-service teachers use technology in the classroom, we have a computer, a data show projector and their attachments in each classroom … it must be used by all the student teachers and all teachers at school.'* (HT2)

The third head teacher (HT3) also indicated his high expectations of the pre-service teachers' use of technology and gave his reasons as facilitating the teaching process and saving time by presenting lesson content instead of laboriously writing on the board. This view also confirmed the only technological affordance of technology that the head teachers recognised and the absence of pedagogical aspects in their responses. It showed that this head teacher expected technology to be used to support traditional transmission teaching, indicating the same view of his colleagues (HT1 and HT2).

> *'We ask them [the student teachers] all to use technological devises because them facilitate teaching process for them … instead of using white board intensively for writing, they use projector, it facilitates their job and saves their time.'* (HT3)

This head teacher (HT3) also believed that pre-service teachers are able to use technology more effectively than in-service teachers. Unlike the first head teacher (HT1) who thought pre-service teachers were very weak in technology use in education, this head teacher (HT3) thought in a general sense about the technological skills of younger people, who are expected to be more skilled in technology. This seemed to be a good reason to expect pre-service teachers to integrate technology into their teaching in this head teacher's view.

> *'I think the trainee is able to use technology and skilled in technology even better than the school's teachers, because of that we encourage him to use it and take its advantages.'* (HT3)

Regardless of his own view about technology use in education or the school regulations, this head teacher showed more concern about the pre-service teachers' training needs than did the other head teachers, who talked about their expectations according to their school's needs and the expected benefits. This head teacher indicated that he expected pre-service teachers to use technology and encouraged them to do so because he wanted to prepare them as trainees for teaching in the future where they would need to integrate technology into their practice. However, he stated that some pre-service teachers responded to his expectations and encouragement positively by using technology in the classroom and some of them did not accept this view and carried on using non-technological tools.

'I ask them during their training to implement what they are expected to do in the future when they become real teachers … However, there are differences between them in accepting this view. Some of them accept our instructions … some of them show less acceptance or interest … but trainees must use technology in the light of this technological revolution.' (HT3)

Similarly, the fourth head teacher (HT4) also showed a high expectation for the pre-service teachers' use of technology in the classroom. He also seemed to expect the use of technology in general regardless of the strategy of its use or the teaching style, stating that technological tools now replace non-technological tools. This view can be seen in the following quotes of his interview.

'Pre-service teachers are required to use technology in the classroom by the school and the university.' (HT4)

'Technology now has replaced classic [non-technological] tools … therefore, any tutor who comes from the university asks them to use technology.' (HT4)

In contrast, five of the seven pre-service teachers interviewed stated that nobody expected them to use technology in the classroom and those who used technology said that they used it because they wanted to do so. However, this conflict between the head teachers' and the pre-service teachers' statements could be a result of a weakness in the pre-service teachers' training operation and management. This could indicate a gap in the communication channels between them. For example, the science pre-service teacher (PST1 science) argued that the school did not require or support technology use. However, he stated that his use of technology was appreciated by the school but if he did not use technology no one would talk to him about this issue. He also stated that he used technology in the classroom because he was aware of its importance and he was convinced to integrate it into his practice without any support from the school community.

> *'In my case, the school does not require or support the use of technology. If I use it in my teaching this will be good, but if I do not use it nobody will talk about that. My use of technology is because I want to use it and I am convinced about its importance, not because of any support from the head teacher, cooperating teacher or the others.'* (PST1 science)

Another science pre-service teacher (PST3 science) agreed with his previous colleague stating that there was no policy related to the use of technology in teaching and, if there was, he had not been informed about it. He argued that the school was not concerned about technology use.

> *'As I told you earlier, the school management is not concerned about the use of technology in general … so I do not see any active policy that requires technology use … at least I have not been told about such a policy.'* (PST3 science)

The mathematics pre-service teachers also shared this view with their science colleagues. Schools expected the pre-service teachers to teach and achieve the lessons' aims and objectives regardless of the teaching strategy, which could be either by using non-technological or technological tools, according to a mathematics pre-service teacher (PST4 math). He seemed to believe that pedagogical aspects were not a part of the school priority list; rather, they focused on the outcome regardless of the nature of practice in the classroom. This view is seen in the following extract.

> *'Practically, what I see is that either I use technology or not, all the same, especially by the school management. They want me to teach the lessons regardless the teaching strategy or the tools used.'* (PST4 math)

The other mathematics pre-service teacher (PST5 math) who used technology regularly in his teaching also agreed with his colleague, stating that the teaching strategy was not the focus of the school management, who just required teaching the lessons and achieving the objectives. The strategy was up to the pre-service teacher himself.

> *'Their expectation is clear … they want me to teach lessons and deliver knowledge to pupils properly regardless of teaching strategy … this is entirely up to me.'* (PST5 math)

Although this pre-service teacher stated that there was no explicit requirement by the school to use technology, unlike the other pre-service teachers, he believed that the general atmosphere at school encouraged the use of technology. The desire of pupils, as presented earlier in this chapter, the availability of technological tools, and the support from the cooperating teacher in addition to his own belief about the role of technology in education seemed to be important factors in the school setting that encouraged this pre-service teacher to adopt technology in his teaching.

> *'There is no explicit requirement of using technology at school, but I can see that there is a general trend toward technology use and taking its advantages.'* (PST5 math)

> *'Nobody asked me to use technology in my teaching … there is encouragement by the cooperating teacher … what is important to them is delivering knowledge and achieving objectives regardless teaching strategy as I explained to you.'* (PST5 math)

> *'School environment helps in using technology, but there is no explicit requirement from the school management to use it … and also there is no obstacle that hinders the use … it is my choice.'* (PST5 math)

In addition to those who used technology in their teaching, the mathematics pre-service teacher (ST6 math no tech) who did not use technology also highlighted the lack of school expectations or support for using technology in the classroom. Although he admitted that the school provided technological equipment, this seemed not to be enough to show a high expectation for using technology. He believed that they merely provided the equipment without any support or encouragement to use it. As explained earlier in this chapter, this pre-service teacher held a different pedagogical view from his colleagues and seemed to expect more from the school by way of integrating technology into teaching in a more learner-centred approach. This could have influenced his view about the available technology and school expectations. He also went further and argued that this equipment was put in the classrooms only as 'decoration' not for actual use as it was not in the priority list of the school. The following quotes are some examples of this view.

> *'The school is not concerned at all about the use of technology particularly. They provide classrooms with technology and give teachers the equipment such as computers and projectors, then it does not seem that they expect its use in teaching. If they were concerned about technology they would be concerned about its maintenance, support …etc. The school does not do that, there is no concern.'* (PST6 math no tech)

> *'Whoever expects me to use technology and activate it in the classroom should at least show some concern about it and its condition. Actually there is no concern at all. It seems to me that they put it just as decoration for the classroom.'* (PST6 math no tech)

It was not only the student teachers who reported the lack of expectation of their use of technology by the school, but also the university tutors. Three of the four university tutors interviewed stated that schools did not encourage the pre-service teachers to use technology in their teaching. For example, the first university tutor (UT1) argued that the majority of schools did not show any interest in activating the use of technology in the classroom. He believed that the majority of schools looked at the pre-service teachers as a 'solution' to overcome the lack of teachers at school and expected them to perform teaching regardless of their strategy. Therefore, schools did not show a significant concern about the training or preparation of pre-service teachers. This could explain the lack of communication between school community and the pre-service teachers and lack of concern about their training needs.

> *'It is very rare to find a head teacher who is concerned about this thing [the use of technology], the majority, to be honest, are not concerned. The important thing to them is to overcome the lack in the number of staff by the pre-service teacher and to perform the lessons' teaching regardless of the teaching method.'* (UT1)

Another university tutor (UT3) also stated that schools were not concerned about the use of technology in the classroom. Similar to what his previous colleagues noticed, this university tutor believed that schools did not guide the pre-service teachers to specific teaching strategies or tools, rather, they expected the lessons to be delivered and the objectives achieved regardless of the teaching style. This was left entirely to the pre-service teachers themselves.

> *'I think schools are not concerned about the use of technology in the classroom to some extent. I might say that the strategy is leaving the pre-service teachers to perform teaching in any way.'* (UT3)

Another university tutor (UT4) interpreted this issue from a slightly different point of view. He thought that schools would leave the pre-service teachers to choose their preferred teaching style unless they showed an interest in technology. In this case, the school would provide support and help to the pre-service teacher.

> *'Schools do not impose the use of technology on the pre-service teacher, but some schools help pre-service teachers and provide them with support for using technology if they find the pre-service teacher interested and keen to use it … but if the pre-service teacher does not use technology or show interest in it, they do not impose it on him.'* (UT4)

This view could partly explain the lack of communication between the school community (especially head teacher and cooperating teacher) and the pre-service teachers. It might be the case that the pre-service teachers wait for the school to guide them towards desired strategies of teaching and provide them with support, while the school waits for the pre-service teachers to ask for help and support in a specific type of practice. However, this indicates a lack of organisation and management of the training settings and a lack of clarity in the roles and responsibilities of the stakeholders involved in the pre-service teachers' training (pre-service teachers, university tutors, head teachers, and cooperating teachers).

Another issue that was raised during the interviews which could contribute to understanding the reason behind this lack of communication or ‘misunderstanding’ among the pre-service teachers was the view of head teachers and school community about the pre-service teachers themselves as a part of the school community. It seems that, to some extent, schools did not rely on the pre-service teachers’ teaching abilities and skills, and did not count on them to take important roles in the teaching and learning process at schools. This issue was raised by at least one participant in each of the participant groups of this study; pre-service teachers, university tutors, and head teachers. For example, the mathematics pre-service teacher (PST6 math no tech) who did not use technology in his teaching stated that he was seen as a ‘guest’ who would soon leave the school and the school did not count on him to teach its pupils.

> *‘What I noticed is that, they treat me as a leaving guest, I am not a teacher at school and they do not rely on me to teach the pupils at school.’* (PST6 math no tech)

In short, the lack of communication between the pre-service teachers and the school staff might have led the pre-service teachers to assume the lack of expectations of using technology in the classroom. In addition, the school staff’s views about the role of pre-service teachers and their position at school seemed to affect their identity and their understanding of agency. This issue is discussed in more detail in the discussion chapter later.

7.3 Influence of university settings on the pre-service teachers’ use of technology

The university setting during the pre-service teachers’ study prior to their teaching practice was found to be an influential element on their actual use of technology during teaching practice. It seemed to play a vital role in the pre-service teachers' identity, pedagogy and practices in the classroom among those who actually used it in their teaching.

7.3.1 Use of technology by university staff

The university lecturers' use of specific types of technology was reported by those who used technology as a reason behind their adoption of the same types of technology in their teaching. Pre-service teachers were found to imitate their lecturers' teaching style and observe this teaching style as a model for their practical knowledge. In this regard, three of the pre-service teachers who used technology (PST1 science, PST2 science and PST4 math) stated that their lecturers at university used visual presentations through technology such as PowerPoint in their lectures. This type of technology use by lecturers seemed to significantly contribute in forming their pedagogical identities, in which they adopted a traditional transmission strategy of teaching using technological visual presentations as supportive tools to increase the interest of students and draw their attention during a 'boring' lesson. All the three pre-service teachers indicated that the use of technology at university by staff and academics has familiarised them with its use and convinced them of its importance. For example, the first science pre-service teacher (PST1 science) mentioned that the existence of technological equipment and the use of these technologies everywhere at the university had convinced him of its important in education.

> *'At the university, when you go to any office or a classroom you find it working with technology, so, from my study at the university, I learned a lot about dealing with technology and I was convinced of its importance in education.'* (PST1 science)

However, he admitted that the use of technology for educational purposes was limited to visual presentations through projectors. This limited use of technology seems to have had a significant influence on his pedagogical views and perceptions about the affordances of technology, pushing him to adopt the same tools and teaching strategy.

> *'The focus was on the use of projectors and presentation software, there are some technologies that we did not learn to use such as visualiser presenters and interactive whiteboard.'* (PST1 science)

The other science pre-service teacher (PST2 science) also highlighted the same issue stating that the use by university lecturers of this type of technology was the main reason behind his use of the same technology in his teaching. Now he was familiar with it.

> *'Our teachers at university, especially the educational technology teachers, used to use it constantly in their teaching, because of that I am familiar with this type of technology, there is a trend that we implement it in our teaching in the classroom.'* (PST2 science)

> *'Firstly through the use of such technology by teachers at university such as the use of projectors for presenting slides or images or videos.'* (PST2 science)

The same went for the third pre-service teacher (PST4 math).

> *'I learned the use of interactive whiteboard at university … our teachers used to use it.'* (PST4 math)

On the other hand, the pre-service teachers who did not use technology in their teaching at school (PST6 math no tech and PST7 science no tech) showed that the university had an influence on their view about the use of technology in a different way than those who used technology. For example, the mathematics pre-service teacher (PST6 math no technology) showed a significant influence of his university lecturer, who adopted an interactive strategy of teaching, on his pedagogical views. As presented earlier in Chapter Six, this pre-service teacher refused to use technology unless the whole system was readied in terms of preparing the school, pupils and parents to accept an interactive teaching strategy through technology. This pedagogical view suggested that this pre-service teacher had been convinced of the importance of an interactive teaching strategy and the active role of learners by his university lecturers who had adopted this strategy. Therefore, he required a 'ready environment' in order to apply the same strategy and the same use of technology in his teaching at school. This influence can be seen clearly when he highlighted the role of his university lecturer several times during the interview.

> *'At the university, I studied with a teacher who used interactive whiteboard, we learnt that it is connected to memories and to the internet, and that we can access from home to review content inputted in it. This comprehensive use that is beneficial for learning, which all related people perform their tasks on it.'* (PST6 math no tech)

It is clear that this pre-service teacher had recognised the technical and pedagogical affordances of technology (interactive whiteboard in this case) through his university lecturer's use of such technologies as interactive tools to support a constructivist learning strategy (learner-centred strategy). This raises the issue of the importance of the university setting and the practices performed within this setting in forming the pre-service teachers' pedagogical identity and their understanding of agency. This is apart from what is intended to be formally taught to students as academic content, and the results show that it influences their practice significantly. Therefore, more attention should be given to the university's teaching practices and strategies in order to develop the pre-service teachers' pedagogical identity.

The other pre-service teacher (PST7 science no tech) who did not use technology seemed to have been less influenced by the university in his practice regarding the use of technology. Although he recalled a positive attitude towards the use of technology by his university lecturers, he did not seem to believe in its suitability for teaching children in primary schools, as presented earlier in Chapter Six.

> *'Even in my study at university, I did not get benefits from technology, except for printing some research and papers in Microsoft Word for example … some teachers used [PowerPoint] presentations … it was actually good, maybe because we were university students, but I do not think it would be in the same effectiveness for primary level.'* (PST7 science no tech)

This influence of the university's academic practices on the pre-service teachers' perceptions and practices related to the use of technology in the school was also mentioned by a university tutor (UT1). He claimed that pre-service teachers acquire their pedagogical views from what they experience from their university lecturers.

> *'He [the pre-service teacher] gains this pedagogical view from his teachers, if the teacher actually uses technology in lectures in the college, the pre-service teacher would gain this experience of how to use technology and how to integrate it into teaching.'* (UT1)

7.3.2 Weak strategy of preparing pre-service teachers for technology use

The previous view of the university tutor suggests that the university strategy of preparing the pre-service teachers for technology use was not clear or well-organised. Not only that, but also it could show the weakness of the pedagogical aspects of the university programme for the sake of teaching content knowledge (pure mathematics and science modules).

Generally speaking, the above finding suggests the importance of the whole university setting, not only what is formally taught to the students, in forming the pre-service teachers' pedagogical identity and their understanding of agency during lessons. It also suggests that the pedagogical aspects need to be given more attention by the educators in order to equip the pre-service teachers with the pedagogical strategies and learning theories needed to be a 'good' teacher who is able to combine the technological, pedagogical and content aspects to provide a ‘good’ lesson. Although there seems to be some effort by the university to promote the use of technology and to show its importance for education according to the first university tutor (UT1), this was not sufficient to make the pre-service teachers go to their school practice with the required skills. This university tutor stated that departments such as curriculum and teaching methods and educational technology departments did conduct training courses and workshops that encouraged the use of technology and that they discussed aspects of pedagogy related to technology.

> *‘The curriculum and teaching methods and the educational technology departments conduct training courses and workshops that promote the use of technology and show its advantages in education and look at the challenges in the use.’* (UT1)

In contrast, another university tutor (UT3) admitted the lack of pedagogical preparation for the pre-service teachers in using technology. He added that they had a plan to increase the role of technology and its implementation in the classroom at the university and to train the lecturers themselves in these aspects, which in turn would influence the pre-service teachers and promote their use of technology in schools according to this tutor.

> *‘We have a future plan here at the university to more activate the role of technology and increase its use in the classrooms through the activation of interactive whiteboard and its applications, also to train the staff in this use, which could in turn influence the pre-service teachers’ cognition and promote their technology use at schools.’* (UT3)

7.3.3 University expectations for the use of technology

The analysis of the interview data showed that all four university tutors expected pre-service teachers to integrate technology into their teaching, as they thought the pre-service teachers had previously been well-prepared in the use of technology in education during their university study. However, the university tutors mentioned certain limitations on the level of their expectations regarding technology use in some schools, such as the availability of equipment and other factors to be presented in this section.

The first university tutor (UT1) thought that pre-service teachers were expected to integrate technology into their teaching as they had received good preparation in technology use in education. However, and in reality, the integration of technology was limited among the pre-service teachers due to the lack of technological equipment in many schools according to this university tutor. He believed that this lack of equipment had significantly limited the pre-service teachers' use of technology in the classroom.

> *'The trainees are expected to employ technology in teaching, but actually, you hardly ever find a real employment of technology due to the lack of technological equipment in many schools. However, what the pre-service teachers learn at university is to employ technology in teaching … this is what we hope at the university.'* (UT1)

The second university tutor (UT2) also agreed with his previous colleague about the limited use of technology, giving more factors that could have negatively influenced the pre-service teachers' adoption of technology. These factors lowered the university tutor's expectations of technology use by the pre-service teachers in reality. Almost all the components of the school setting were seen by this university tutor as contributors in limiting the actual use of technology by the pre-service teachers at schools. The school culture, circumstances, the actual training the pre-service teachers received at school, and their personal beliefs about the value of technology were all seen by this university tutor to be factors limiting the adoption of technology which, in turn, decreased his expectations of the use of technology by the pre-service teachers.

> *'During the training period, we expect pre-service teachers to use technology, tutors seek to support them and persuade them to use*

> *technology in their teaching. But it depends really … this issue is limited by many factors; the view of the pre-service teachers themselves, surrounding circumstances, school setting, subject contents, actual training they receive at school, the pre-service teachers' skills … sometimes they have the theoretical part related to technology but the implementation is different.'* (UT2)

As can be seen in the quote above, this university tutor raised another issue that the university tutors thought to limit the use of technology by the pre-service teachers, which is related to the implementation of theoretical ideas. This issue of the relationship between theory and practice was admitted by this university tutor to limit the adoption of technology among the pre-service teachers when they go to school for training. This could indicate an issue in the pre-service teachers' preparation and in the training organisation. The organisation of the partnership between university and school and its influence on the pre-service teachers' perceptions and practices are discussed in the next section of this chapter.

7.4 Partnership between university and school

This section presents finding related to the partnership between university and school and its influence on the pre-service teachers' perceptions and practices of the integration of technology in the classroom. As the pre-service teachers should translate the theoretical knowledge gained at the university into practice during the school placement period, there seem to be issues related to this transfer from theory to practice. The interview analysis revealed that several issues had actually influenced the pre-service teachers' adoption of technology in their teaching. These issues are presented in more detail in the following sub-sections.

7.4.1 Gaps between theory and practice

As the balance between theory and practice is a major concern in the pre-service teachers' training, the interview data analysis revealed that there was a disconnection, to some extent, between the university programmes and the school reality and needs. This disconnection appeared as a gap between theory (given at university) and practice (existing at school) according to the views of most of the study participants. This gap seemed to include aspects related to the use of technology in education in general and in the classroom in particular.

Three of the seven pre-service teachers interviewed (PST2 science, PST5 math, and PST6 math no technology) thought that there was a gap between the university programme and the actual practice at school and its needs. For example, the science pre-service teacher (PST2 science) indicated that the educational system and curriculum at school were more advanced and the university programme had not kept up with them. He thought that the university programmes were old and needed to be updated in order to be consistent with the schools' reality.

> *'Curriculums and systems at schools are advanced and updated continuously, the university does not cope with that … modules' contents at university are relatively old and not consistent with the new curriculum at school.'* (PST2 science)

Another pre-service teacher (PST5 math) also agreed with his previous colleague addressing that what they had learned at university about the use of technology in education was only basic technological tools with no training and without linking their use with the reality at school and its needs.

> *'There was some preparation for technology use, basic tools like projectors and presentations, but without connection with the actual practice at school and there was no practical training.'* (PST5 math)

He added that the university programmes focused on theoretical aspects only. Moreover, these theoretical aspects given at the university seemed to be far away from the actual practice at school and its needs according to his point of view. He thought that the new curriculum and its requirements were not well-considered by the university programmes and there was a big difference between what was given at university and what existed at school.

> *'The university gives theoretical aspects only, for education in general and for educational technology use particularly, everything is theoretical, very far from reality at school. The new curriculum with all its requirements is not considered by the university. There is a difference between what we learned and what actually exists at school, there is a defect.'* (PST5 math)

From the above, it can be argued that the limited use of technology by the pre-service teachers and the relative lack of awareness of its various affordances in education among them that was noticed clearly in this study could have been caused by the gap between theory (at university) and practice (at school).

On the other hand, the pre-service teacher who did not use technology in his teaching (PST6 math no technology) saw this issue differently. He believed that the gap between university programmes and school practice was indeed significant. However, and unlike the previous two pre-service teachers who used technology, this pre-service teacher believed that the university programmes were more advanced while the school was not ready to host pre-service teachers coming from such programmes. As explained earlier in the previous chapter, this pre-service teacher held different pedagogical views than his colleagues, tending to believe more in interactive constructivist ways of learning. This might have made him focus on theoretical aspects at university and become interested in translating these aspects into school practice, which was difficult due to the lack of readiness at school to apply such approaches, in his view. In contrast, the previous two pre-service teachers (PST2 science and PST5 math) seemed to hold traditional transmission views of teaching which were consistent with the actual school practice, so they saw the school as more advanced.

> *'The current school is not the school that the university prepared as for. University aims to graduate a qualified teacher not like the old teachers who depend on traditional teaching, a modern teacher who copes with the new era including technology. Our schools are not prepared for that, there is no consistency between them. What the university aims to achieve is much higher than the school reality.'* (PST6 math no tech)

In addition to the pre-service teachers, all the four university tutors interviewed pointed clearly to the gap between the university programmes and plans and the actual practice adopted at school. This was thought by the university tutors to be a significant issue that influenced the pre-service teachers' use of technology in their teaching. However, they thought this gap was caused mostly by the head teachers' pedagogical views, who sometimes forced the pre-service teachers to follow the general pedagogical views adopted in the school. This indicated that the university tutors did not see a large gap between the university and schools, rather, they seemed to believe that the personal beliefs of some head teachers were likely to influence the pre-service teachers' adoption of technology. For example, the first university tutor expressed the view that, while the practical training of the pre-service teachers should be a translation of what had been learned at university, this did not happen due to the head teachers' pedagogical views that were sometimes inconsistent with the university programmes.

> *'You know that practical training is a translation of what they learn at university, such as theories, concepts and so on. Most of the pre-service teachers say that they cannot apply what they have learned into their practice at school. There is no conviction among head teachers and parents.'* (UT1)

In addition, the poor school setting and the lack of readiness of this setting to apply different teaching methods with technological tools was seen to be the cause of the gap between university and school, according to the second university tutor's view. He believed that the pre-service teachers were well-prepared at university but when they went to schools for training, they faced poor settings that did not allow them to apply what they had learned. This could also indicate the lack of school placement management by the university where pre-service teachers were sent to unsuitable schools. However, and as presented earlier in this chapter, the large number of pre-service teachers going to schools every term might have prevented the university from sending them to selected schools.

> *'To be honest, there is a gap between preparation [at university] and training [at school]. In our programmes, the pre-service teachers go to training during the last term of their study. They are sometimes hurled at schools that are not suitable settings.'* (UT2)

Another university tutor (UT3) spoke about a higher level when he discussed this issue. He believed that, theoretically, the university and schools' aims were consistent, and that their partnership was driven, also theoretically, by the same pedagogical and theoretical principles. However, he argued that the issue could appear during the actual practice when the views of head teachers and teachers or the nature of school setting became an obstacle to implementing these principles.

> *'I think the university programmes and the theoretical vision of the Ministry of Education are completely consistent regarding the use of technology in education, but the problem in in the actual practice in some schools. I think the nature of school management, teachers, nature of classroom settings in some schools do not allow that.'* (UT3)

Similarly, the fourth university tutor (TU4) believed a gap existed between the university programmes and the actual practice at school. He argued that this gap was caused by the lack of 'working together' culture among the two institutions which made the difference between the university outcomes and what the schools actually needed. He added that there was a lack of communication between them in order to coordinate their work.

> *'There is a real gap between what the school needs and the college outcomes in general and for technology use in particular. There is no effective communication to determine the schools' needs and the skills that the school demands from the university.'* (UT4)

In the same regard, two of the four head teachers interviewed addressed the gap between university outcomes and school needs. They both argued that the university outcomes were far behind the actual school needs. For example, the first head teacher (HT1) complained that the university caused this gap as the pre-service teachers came to schools with lack of knowledge in how to integrate technology into teaching. He added that the pre-service teachers' knowledge and skills were remote from the actual needs of the schools due to the old university curriculum that was inconsistent with current school practice.

> *'Indeed, there is a gap between the school and the university, I do not know how to diagnose this gap accurately, but there is a gap. Is it in the supervision by the university? Is it in their programme? … They do not use technology properly and they do not know about its importance.'* (HT1)

> *'There is no connection or compatibility between university and school. Even in the technological preparation, I think it is far away from the schools' needs. I think they teach the old curriculum which is not compatible with the school's reality.'* (HT1)

It was not only the university programme's theoretical aspects that were far from the actual practice but also, during the training, tutors seemed to focus on the theoretical aspects only without considering the implementation of these aspects practically by the pre-service teachers. The first head teacher (HT1) argued that, during the training, tutors focused on theoretical aspects of teaching, such as lesson plans and their contents, and neglected the actual practice and the implementation of the these plans. This neglect of implementation might have led to a poor translation of theory into practice among the pre-service teachers. Moreover, this neglect might be caused by the weak connection and communication between university and school which led tutors to focus on the part related to the university, which is mostly theoretical.

> *'The tutor asks the student teachers to prepare lesson plans and worksheets without any concern about implementing them practically. He does not know whether they use technology, nor does he encourage them to use it.'* (HT1)

The other head teacher who addressed this issue (HT2) thought that the university did not give enough attention to the use of technology in education during the pre-service teachers' study. He believed that there should be much more attention given to technology use in order to implement it at school.

> *'Now the use of technology is everything, education depends on it significantly … but the university did not give enough concern, there should be more attention given to technology.'* (HT2)

This head teacher raised another issue, that of the lack of English language among the pre-service teachers, which consequently influences their use of technology negatively as most technological aspects and software are in English. This issue of language had also been raised previously by a pre-service teacher, as presented earlier in the previous chapter, which made him seek help from his brother who had a better level of English language. According to this head teacher, the university should improve the pre-service teachers' English language in order to be able to deal better with technology.

> *'All the computer software is in English, how can they deal with it? There is a weakness in the university programmes regarding technology and English language.'* (HT2)

From the above, it can be argued that the nature of the school chosen for training and the way this school is run, play a vital role in the quality of the pre-service teachers' translation of their theoretical knowledge into practice. This suggests that there is a need for stronger relationships which would lead to stronger partnerships between university and schools. This demands choosing the specific schools that are able to provide the pre-service teachers with the opportunity to translate their knowledge into practice.

7.4.2 Partnership organisation

From the previous section on the gap between theory and practice, it can be argued that the process and strategies of organising the partnership between university and school needs to be given more attention in order to improve the pre-service teachers' training. In this regard, the poor organisation of the partnership between university and school was widely reported by the participants and seen as an issue that could negatively influence the pre-service teachers' use of technology. Two main issues related to the poor organisation of the partnership were reported by three out of the four university tutors interviewed (UT1, UT2 and UT3). The first issue was that the pre-service teachers were seen as assistants to the school teachers and that their job was to support the school staff according to the school policy; this was far from the university programme. This issue was mentioned by the first university tutor (UT1), who bemoaned the fact that many of the head teachers looked at the pre-service teachers as 'guests' who would stay for a short period and cover the shortage of teachers, acting as temporary assistants for the existing teachers.

> *'As I told you, most of the head teachers look at the pre-service teacher as a guest who is exists for a period of time, who covers the shortage in numbers of teachers at school.'* (UT1)

The other issue related to the poor organisation of the partnership reported by the university tutors was the poor introduction of the pre-service teachers into the school setting. The training policy showed that the pre-service teachers should attend lessons with the cooperating teachers for at least one month before they start teaching. However, this did not always happen according to two of the university tutors (UT2 and UT3). They reported that the pre-service teachers were left alone in the field and sent directly to the classroom to teach independently. This issue was seen as a major one that needed to be considered at the beginning of the training, as the training policy strongly highlighted.

> *'The problem that faces most of the pre-service teachers is that they go to schools with no experience and the head teachers give them timetables and let them go to the classroom … sometimes they make major mistakes that are not taken into account.'* (UT2)

> *'From my visits to schools, I think most of the schools leave the pre-service teachers alone in the field. They should attend with cooperating teachers for at least one month for general watching and specialised watching with teachers. Sometimes we are surprised that from the first week they are sent to the classrooms to be in the lead from the beginning.'* (UT3)

On the other hand, head teachers thought that the university was responsible for the poor organisation of the partnership between the two institutions. For example, one of the head teachers (HT2) believed that the pre-service teachers should be prepared and familiarised with the school policy and regulations by the university before they are sent to the school for training. He indicated that there was a need for more effective communication between the university and school in order to overcome this issue.

> *'They need to know the school's policy and its regulations before they are sent to schools. There has to be more effective communication with schools before training.'* (HT2)

Moreover, another head teacher (HT3) lamented the lack of communication or coordination between university and school many times during the interview. He gave this as the reason behind the poor organisation of the partnership between them. The following quotes are examples of his thought.

> *'The pre-service teacher has to use technology in the light of the current technological revolution; however, there is no coordination and communication between us and the university in this regard.'* (HT3)

> *'I see weakness in coordination between university, school and local authority, because we do not know how the pre-service teachers are prepared at the university.'* (HT3)

In this regard, one of the university tutors (UT2) admitted the lack of preparation of the pre-service teachers for the schools' policy and regulations by the university, which supports the head teacher's previous complaint. This preparation was limited to giving the pre-service teachers some general instructions and information about schools in the training guidelines.

> *'Indeed, there is no real preparation for the pre-service teachers in the school's regulations, this might happen in a limited range through general instructions in the training guidelines or in the letter sent to the head teachers that includes the basic aspects that they need to follow.'* (UT2)

Furthermore, sending the pre-service teachers to schools which could not support their training in an effective manner due to lack of facilities was reported to be an issue that affected the partnership between university and school, as mentioned earlier in this chapter. This issue was raised by a pre-service teacher (PST6 math no tech) who suggested selecting only those schools for training that could effectively support the partnership and meet training needs.

> *'University should choose specific schools for training that are good, and support these school in providing what the student teachers need during the training such as technological equipment.'* (PST6 math no tech)

However, this was impossible in light of the large number of the pre-service teachers every term, according to a university tutor (UT1). He argued that this was the aim that the university sought to achieve but that they were forced to send students to 'rented' schools that lacked equipment.

'We planned to send trainees only to state schools, but we found the large number of trainees an obstacle. In the past, the number of trainees was small and we sent them to schools with official buildings only, it was very successful and there was no issues with the technology use.' (UT1)

7.4.3 Organisational challenges

Organisational challenges were mostly reported by the university tutors who were responsible for the relationship between university and schools regarding the pre-service teachers' school placement. These organisational challenges, which affected the pre-service teachers' use of technology, were seen most clearly by the university tutors.

Two of the four university tutors reported organisational challenges that they thought affected the use of technology in the classroom by the pre-service teachers. First of all, the first university tutor (UT1) addressed the issue of sending the pre-service teachers to 'rented schools' where buildings were not suitable for technology integration due to their lack of equipment, small rooms, and other issues related to the buildings which were not originally designed to be schools. However, he suggested sending the pre-service teachers only to schools with suitable or 'official' buildings that were designed to be schools and equipped with the necessary technology and other equipment. He added that this had been done successfully in the past when no problems related to technology use had been reported. This is illustrated in the quotation above.

Another organisational challenge reported by the same university tutor was the lack of concern on the part of some head teachers about the pre-service teachers' training. He believed that some head teachers were busy with managing their schools and looked at the pre-service teachers merely as assistants who could cover the shortage of teachers. This lack of concern by the head teachers was seen to be an obstacle to the training setting organisation which, in turn, affected the pre-service teachers' use of technology.

> *'The head teacher is busy with his teachers and busy with his school activity; his only concern about the pre-service teachers is to cover the shortage of the number of teachers in his school and to assist them.'* (UT1)

The difference between university outcomes and the schools' needs was reported by a university tutor (UT4) to be an organisational challenge that affected the pre-service teachers' use of technology. He admitted that the university curriculum related to technology use might be out of date and was not consistent with the schools' needs in this regard. This raises the issue of coordination of the university's and schools' objectives, which ought to be oriented in the same direction in order to achieve coherence of the general educational aims.

> *'We have some curriculum and modules that are out of date, some of them designed in the nineties, we try to update them but we could not because of the complicated process needed to make this change, we were asked to follow this old curriculum which is not consistent with the schools' needs nowadays.'* (UT4)

7.4.4 The lack of clarity in the assessment criteria

One important aspect that could affect pre-service teachers' expectations for using technology in the classroom is the assessment criteria. When I reviewed the assessment criteria and the evaluation forms on pre-service teachers' performance by the university tutor, head teacher and cooperating teacher, I found no mention of the use of technology. There was just one item on each of the three assessment forms on whether the pre-service teachers used instructional means or 'tools' in general. The generality of this item seemed to lead to subjective interpretations by the examiners (university tutor, head teacher and cooperating teacher), which led to a lack of clarity about the expectations and assessment criteria among the pre-service teachers.

In this regard, the interview data analysis revealed that, when they were asked about the assessment criteria regarding the use of technology, all four university tutors indicated that the assessment forms included items about the pre-service teachers' use of technology in the classroom. However, when they discussed this issue in depth during the interviews, they stated that the use of technology was assessed using the item related to the 'instructional means' in general. For example, the first university tutor (UT1) said that there was an item to assess the pre-service teachers' performance with regard to technology use.

> *'Yes there is an item, yes. There is an item that assesses the pre-service performance by the university tutor regarding the use of technology.'* (UT1)

As the interview continued, he added that he assessed the pre-service teachers' use of technology such as presentations through a data show projector or interactive whiteboard using the item related to their use of instructional means.

> *'For the item about the use of instructional means, the most important thing we focus on is the data show projectors, interactive whiteboard, and how these are employed in the teaching and learning process.'* (UT1)

However, this university tutor stated that his assessment of his pre-service teachers' technology use was subject to the availability of technological equipment at the school. If the equipment was available, then the pre-service teachers were asked to use it and were assessed based on this use, according to this university tutor.

> *'If technology is available at school, I assess the pre-service teachers' performance according to their technology use … I tell*

> *them that they will be assessed in technology use from the beginning of the term.'* (UT1)

Similarly, the other three university tutors (UT2, UT3 and UT4) also showed this type of subjective interpretation of the assessment criteria, which resulted in a lack of clarity about these criteria among the pre-service teachers, as will be shown later in this section. The following quotes are examples of this subjective interpretation by the university tutors.

> *'Of course the use of technology is included in the assessment … or in general the use of instructional means … if I attend a lesson with the pre-service teacher and I find him teaching in an effective way, his mark won't be affected regardless the use of technology.'* (UT2)

> *'We assess the pre-service teachers according to a set of criteria, as I said to you the use of technology or the instructional means in general is part of the mark given to the student.'* (UT3)

> *'Yes I assess them according to their technology use. I also tell them that the use of technology is an important part of their assessment … There is no clear item about the use of technology particularly, however, we attempt to encourage them to use technology in their teaching … we expect them to use it but there is no written policy about that.'* (UT4)

Furthermore, two of four head teachers (HT3 and HT4) also showed a similar interpretation of the assessment criteria. When asked about this issue they indicated that pre-service teachers were assessed according to their technology use in the classroom.

> *'There are lots of items, including the use of technology, do they use it, and how they use it … in addition to many other items.'* (HT3)

> *'Yes of course, they are assessed according to their technology use.'* (HT4)

However, and similar to the university tutors, they admitted that this assessment of technology use was covered by an item related to the use of instructional means in general not technology in particular.

> *'There is no explicit item about the use of technology particularly, but for the use of instructional means in general we use this item to assess their use of technology.'* (HT3)

> *'The use of technology is assessed through the instructional means item, when assessing the pre-service teachers, I consider the use of technology in the classroom.'* (HT4)

In contrast, the other two head teachers (HT1 and HT2) seemed to be more objective regarding this issue as they explained that, since there was no explicit mention of the use of technology in the assessment criteria, they did not assess the pre-service teachers according on it. However, one of them (HT1) regretted that it was not included in the assessment as he believed in the importance of including technology.

> *'Unfortunately, they are not assessed according to technology use … actually we do not look at their use of technology during the assessment.'* (HT1)

> *'It is not included in the assessment. The assessment is for the use of instructional means in general, not for technology particularly.'* (HT2)

This lack of clarity regarding the assessment criteria and their subjective interpretation by university tutors and head teachers, which differed from one to the other, seemed to affect the pre-service teachers' understanding of the 'subjective norm' regarding their use of technology. In other words, the lack of clarity in the assessment criteria may have led to the pre-service teachers being 'not sure' about what they would be assessed on. The interview data analysis revealed that all the seven student teachers interviewed, including those who did not use technology, stated that they were 'not sure' or they 'do not think' that they were assessed on technology use in the classroom. The following are examples of the lack of clarity about the assessment criteria related to the use of technology that the pre-service teachers showed.

> *'I do not think technology use is included in the assessment, I do not know, nobody told me that.'* (PST1 science)

> *'I do not know, as I am aware, technology is not part of the assessment … maybe the whiteboard but other tools, I am not sure.'* (PST3 science)

'I guess technology is not included in the assessment, because the head teacher and the tutor did not ask me to use it … the important thing is to teach in a good way and to deliver the knowledge to the pupils.' (PST5 math)

7.5 Summary of the chapter

This chapter has presented the second part of the qualitative findings related to the influence of the university and school settings on the pre-service teachers' use of technology in the classroom. I presented various elements within the practice settings (school, university, and the partnership between them) that the participants reported to be important factors influencing the pre-service teachers' perceptions and practices related to the integration of technology in the classroom. I also presented findings from those who did not use technology and the influence of the practice settings on their decision.

8 Discussion

8.1 Introduction

This study was conducted to explore the Saudi Arabian science and mathematics pre-service teachers' perceptions and practices of the integration of technology in the primary school classrooms during their school placement. Their school placement takes place within two different institutions (university and school) and each has its own policy and agenda. Thus the complexity of the practice environment increases and the context might become problematic due to potential tensions and contradictions between the two institutions' goals. Therefore, the importance of the current study arises from the pre-service teachers' perceptions and practices related to their use of technology in the classroom within this complex context. How their perceptions and practices are shaped within this complex context needs to be understood in order to inform teacher educators and policy makers in the field of education. Thus, the study seeks to answer the following research questions:

- What is the science and mathematics pre-service teachers' perceived technological pedagogical content knowledge (TPACK)?
- What is the relationship between the science and mathematics pre-service teachers' perceptions and practices of the integration of technology in the classroom?
- What is the relationship between the science and mathematics pre-service teachers' experience with technology and their practices of the integration of ICT in the classroom?
- How does the school setting influence the pre-service teachers' perceptions and practices of the integration of technology in the classroom?

- How does the university setting influence the pre-service teachers' perceptions and practices of the integration of technology in the classroom?
- How does the partnership setting influence the pre-service teachers' perceptions and practices of the integration of technology in the classroom?

Both personal and contextual factors were explored to draw a holistic picture of the issue under investigation. To achieve the aims of this study, I used the TPACK questionnaire, classroom observations and interviews to collect data about the relationship between the science and mathematics pre-service teachers' perceptions and practices on the integration of technology in the classroom and the influence of the practice context on this integration. The aim of this chapter is, firstly, to present brief responses to the research questions from the study findings presented in the previous chapters; and secondly to examine the meanings of the main findings which emerged from the quantitative and qualitative data analysis in relation to the wider literature and through the lens of sociocultural theory. It is worth mentioning that, when discussing the main findings in this chapter, I firstly link them to the wider literature in general and then interpret them theoretically according to the multiple frameworks adopted in this study.

8.2 Answers to the research questions

This section provides summarised responses for each research question from the study findings presented in Chapters Five, Six and Seven. As the findings chapters are quite lengthy, I believe that it is important to summarise findings related to each research question before I start discussion and interpretation, in order to put the findings together and prepare the reader for the important issues that are going to be discussed in this chapter. The aim of the section is only to put findings related to each research question together while the second section interprets and discusses main findings theoretically in the light of existing literature.

8.2.1 Research question one

"What is the science and mathematics pre-service teachers' perceived technological pedagogical content knowledge (TPACK)?"

Pre-service teachers' perceived Technological Pedagogical Content Knowledge (TPACK) was examined through quantitative TPACK questionnaire. The aim of this quantitative instrument was to provide background information about the pre-service teachers' different forms of knowledge and to provide a better understanding and justified foundation of the qualitative data from the classroom observation and interviews. I may argue that having information about how the pre-service teachers perceived their knowledge related to the use of technology has helped in interpreting some aspects of their perceptions and practices emerging from the observation and interview data. The quantitative questionnaire was used to obtain a general view of pre-service teachers' perceived knowledge through the responses of a larger sample.

According to the TPACK questionnaire findings presented in Chapter Five, both science and mathematics pre-service teachers perceived that they had high levels of all types of knowledge (TK, CK, PK, PCK, TCK, TPK and TPACK). Both science and mathematics pre-service teachers gave the same pattern of responses to the questionnaire items, indicating that their perceptions of their knowledge were much the same whether their subject was science or mathematics. However, for some technological content knowledge (TCK) items, science pre-service teachers were more likely than mathematics pre-service teachers to indicate higher knowledge. Surprisingly, the pre-service teachers felt more confident in their pedagogical knowledge (PK), even though they were only just starting to teach, compared to their content knowledge (CK), where they had been learning their science/mathematics at university for several years.

8.2.2 Research question two

“What is the relationship between the science and mathematics pre-service teachers’ perceptions and practices of the integration of technology in the classroom?”

The analysis of interview and observation data revealed that both science and mathematics pre-service teachers valued the use of technology in the classroom where it could improve the pupils’ learning and help in achieving the lesson’s aims in a better way. They believed that technology helped in improving the pupils’ learning, saving time and effort, fostering creativity, and organising the lesson through the use of visual modes of technology such as PowerPoint presentations including images and videos. Among all the pre-service teachers who used technology, visual mode of technology such as PowerPoint presentations that contain images and videos seemed to be first in mind when they talked about using technology in the classroom. However, they showed less awareness of other affordances of technology, focusing only on some basic functions of technology such as drawing the pupils’ attention and overcoming hand writing issues, which indicates their limited knowledge about technology’s affordances and what it can offer in the practice of teaching and learning.

The findings show that the main reason for using technology among both science and mathematics pre-service teachers was simply to 'improve' the traditional transmission method of teaching where the pre-service teachers presented their own work to the pupils through visualising concepts technologically. Interestingly, it was found that those who did not use technology held more constructivist learner-centred pedagogical views, as illustrated by comments about giving pupils control over their learning.

Regarding the teaching subject, science pre-service teachers showed more dependence on technology than their mathematics colleagues, who relied more on non-technological tools in addition to technology. As the science pre-service teachers tended to be more traditional and the mathematicians more constructivist (see Section 6.2.3 in Chapter Six), and given the participants' claim that the available technology at schools only supported a traditional mode of teaching, this could partly explain the difference between them regarding the perceived role of technology in the classroom.

8.2.3 Research question three

"What is the relationship between the science and mathematics pre-service teachers' experience with technology and their practices of the integration of ICT in the classroom?"

The use of technology for educational purposes by the pre-service teachers during their university study can be seen as an indicator for their adoption of technology during teaching practice as presented in Chapter Six. This suggests that those who used technology for their study were more likely to adopt it later in their teaching. This might be linked to their beliefs about the value of technology itself for education in general. On the other hand, all the participants (including both users and non-users of technology in the classroom) had adopted technology for personal purposes such as social communication, web surfing, shopping and gaming. They indicated a moderate to intensive use of technology for personal purposes. These findings suggest that the pre-service teachers' personal experience with technology had no obvious influence on their use of technology in teaching or on their beliefs about its value for education, particularly at primary school level.

8.2.4 Research question four

"How does the school setting influence the pre-service teachers' perceptions and practices of the integration of technology in the classroom?"

The school settings seemed to play a vital role in the pre-service teachers' decision to either use or not to use technology. Many factors were reported by the participants that influenced and shaped the pre-service teachers' use of technology in the classroom, including social factors (e.g. relationships with others), technical factors (e.g. technical support and training), and pedagogical factors (e.g. motivations to use specific strategies). For example, all those who used technology indicated that the school setting in general encouraged them to adopt technology in their teaching. The first factor seen by the pre-service teachers as an encouragement factor was the availability of technology in the classrooms. However, for those who did not use technology, the availability of computers and projectors in the classroom was not enough for them to integrate technology into their teaching, especially for those using learner-centred strategies, who thought they would need technologies suitable for individual learning, such as social networking accounts or 'a device per child'.

In addition to the availability of technology, the five pre-service teachers who used technology reported that the pupils' interest was another factor they recognised to be an encouraging factor of their adoption of technology. They indicated that pupils were an important component of the school setting that significantly influenced their choices when planning for lessons.

The relationships with others within the school setting were also reported by some of the pre-service teachers to be an encouraging factor for using technology in the classroom. Other pre- and in-service teachers played an important role in the decision to adopt technology when they provided the advice and support needed by the pre-service teachers. In some cases, the cooperating teacher was found to have a vital role in forming the pre-service teachers' perceptions and practices, especially when the cooperating teacher adopted technology himself. In contrast, the pre-service teachers raised some issues in the school settings that seemed to be discouraging factors. Some of them saw the lack of school expectations of using technology as a negative element at school. Interestingly, those who reported this issue had limited relationships with others at the school, which points to the importance of relationships with others in forming the pre-service teachers' identity.

8.2.5 Research question five

"How does the university setting influence the pre-service teachers' perceptions and practices of the integration of technology in the classroom?"

The university setting during the pre-service teachers' studies prior to the teaching practice was found to be an influential factor in their actual use of technology when they got to the schools for practice. The university lecturers' use of specific types of technology (unintended modelling) was reported by those who used technology as a reason behind their adoption of the same types of technology in their teaching. As most lecturers at university used visual presentations through technology (associated with lecture style) such as PowerPoint, this type of technology use by lecturers seemed to significantly contribute to forming the pre-service teachers' pedagogical identities by adopting a traditional transmission strategy of teaching using technological visual presentations as supportive tools to increase the interest of students and hold their attention during a 'boring' lesson.

In contrast, the pre-service teachers who did not use technology in their teaching at school showed that the university had an influence on their view about the use of technology in a different way than those who used technology. For example, some of them showed a significant influence by university lecturers who adopted an interactive strategy of teaching on their pedagogical views. As presented earlier in Chapter Seven, these pre-service teachers refused to use technology unless the whole system was ready by preparing the school settings, pupils and parents to adopt interactive teaching strategies through technology. This pedagogical view suggested that pre-service teachers had been convinced of the importance of an interactive teaching strategy and the active role of learners by their university lecturers who adopted this strategy. This highlights the importance of university teaching styles and modelling in forming the pre-service teachers' pedagogical identity which in turn influences their practice later at school. Generally speaking, the findings highlight the importance of the whole university setting, not only what is formally taught to the students, in forming the pre-service teachers' pedagogical views and identities.

8.2.6 Research question six

"How does the partnership setting influence the pre-service teachers' perceptions and practices of the integration of technology in the classroom?"

As pre-service teachers should translate the theoretical knowledge they gained at the university into practice during the training period, there seemed to be issues related to this transfer caused by the partnership organisation between university and school. As the balance between theory and practice is a major concern in the pre-service teachers' training, the interview data analysis revealed that there was a disconnection, to some extent, between the university programmes and the schools' reality and needs. What the pre-service teachers had learned at university about the use of technology in education and its affordances were found to be only basic technological tools and applications, with no training and without linking their use with the reality of the school and its needs. This was thought by the university tutors as a significant issue that influenced the pre-service teachers' use of technology in their teaching. However, they thought this gap was caused mostly by the head teachers' pedagogical views who sometimes forced the pre-service teachers to follow the general pedagogical approach adopted by the school (e.g. traditional teaching strategy in some cases).

Theoretically, university and school aims and objectives were consistent, and their partnership was driven, also theoretically, by the same pedagogical and theoretical principles. For example, both institutions work according to an agreed partnership agenda to provide the pre-service teachers with the opportunity to practice different type of teaching and facilitate their training to make the most of the school environment. However, practical issues appeared during the actual practice when the views of specific head teachers and teachers, or the nature of the school setting and its culture, became obstacles to implementing these principles (e.g. traditional teaching adopted by some schools made it difficult for some pre-service teachers to perform other strategies). This gap was caused by the lack of ‘working together’ among the two institutions, which made a difference between the university outputs and what the schools actually needed. An important issue related to the partnership organisation was that the pre-service teachers were seen as assistants of the school teachers and their job was to support the school staff according to the school policy, with no reference to the university programmes and objectives. This led to omitting their actual training needs, limited their role to basic tasks, and negatively influenced their pedagogical identity development.

Moreover, the lack of clarity in the assessment criteria (as presented in Chapter Seven) and the various subjective interpretations of the assessment items by the university tutors and head teachers affected the pre-service teachers' understanding of the ‘subjective norm’ regarding their use of technology. In other words, the lack of clarity in the assessment criteria related to the use of technology in the classroom may have caused the pre-service teachers to be unsure of the basis on which they would be assessed and therefore of how they should adopt technology to achieve a good assessment.

8.3 Discussion of the main findings and their meanings

This section discusses the main findings presented in Chapter Five, Six and Seven and examines their meaning in relation to the wider literature. It discusses six main themes that emerged from the study findings.

1- Naïve views about technology and pedagogy

- The issue of focusing on teaching rather than the pupils' learning
- The role of the relationships with others in forming pre-service teachers' pedagogical identity

2- Technology and affordances: another naïve view

3- Technology affordances and perceived agency: users vs. non-users of technology

4- Technology role and pedagogy: the matter of teaching subject

- The 'replacement' function of technology in science lessons
- The 'additional' function of technology in mathematics lessons

5- Contextual dimensions of beliefs and identity development

6- Challenges and perceived power within the practice context.

In order to discuss these themes and examine their meaning theoretically, I adopted multiple theoretical frameworks to enable me to focus on different aspects of the science and mathematics pre-service teachers' perceptions and practices regarding technology adoption and the relationships between these two domains. The TPACK framework was used to understand the pre-service teachers' perceived knowledge related to the use of technology in the classroom and to provide a foundation for the qualitative findings' interpretation. I also used the affordance theory to gain insights into the pre-service teachers' recognition of what technology could offer them to improve teaching and learning processes. Moreover, the Theory of Planned Behaviour was used to understand different forms of their beliefs and their relationships with the pre-service teachers' practice. Identity and agency concepts were used to understand how pre-service teachers develop relationships with others within the context and to understand the perceived control the pre-service teachers have over their practice which could shape their social relationships. However, it is worth mentioning that the use of identity and agency concepts in this study does not focus on the individual level, but rather I use these domains to better understand the social relationships between individuals within the teaching practice context. All these frameworks and concepts are used under the umbrella of sociocultural theory and informed and oriented by its principles to achieve the aim of the study.

The findings showed that science and mathematics pre-service teachers practise their teaching within a complex context, where their beliefs, identity, agency and teaching knowledge related to the use of technology shape and are shaped by their relationships with the others in the context. Moreover, their area of specialism (science and mathematics) was found to be an influential factor that contributes to shaping their perceptions and practices. The study findings are discussed in this chapter according to the multiple frameworks used in this study putting 'everything together' to understand the relationships between the findings presented earlier.

8.3.1 Naïve views about technology and pedagogy

According to the interview findings, the pre-service teachers who used technology in their teaching believed that the use of technology in the classroom could improve the pupils' learning and help in achieving the lesson aims in a better way. However, they showed naïve views about the pedagogical affordances of technology (mainly presentation technology) in teaching, mainly using technology regularly only because it helps to 'deliver' lessons in a faster and easier way.

8.3.1.1 The issue of focusing on teaching rather than pupils learning

Pre-service teachers who used technology seemed to focus on the technology functions that served their teaching rather than the pupils' learning. For example, when they thought about the role of technology, they seemed to look at technology as a tool that allows information delivery rather than looking at the interaction between the pupils and these tools. However, this could be a result of being novice teachers, as has been reported in many studies on pre-service teachers' use of technology and their pedagogical views about it. It is suggested in the literature (e.g. Alenezi, 2015; Cuckle & Clarke 2003; Meredith, 2011; Niess, 2005) that pre-service teachers focus more on their own teaching process and classroom management than on the pupils' learning. For example, Niess (2005) stated that, at the beginning of teaching experience, "the student teachers were naturally focused on their own teaching and less likely to think about their students' understandings, thinking and learning" (p.521). This seems to be a common issue among the pre-service teachers as new practitioners in the field and a natural action due to their low level of experience. Their focus on their own teaching rather than their pupils' learning is likely to be the reason behind their limited consideration (or recognition) of the other pedagogical affordances of technology that would support other pedagogical strategies, such as a learner-centred strategy where pupils can benefit from technology in constructing knowledge themselves.

Similarly, the pre-service teachers were found to use technology only to save time and effort and organise lesson teaching through the use of visual modes of technology. This low recognition of the pedagogical affordances of technology has been reported in many studies that investigated pre-service teachers' use of technology, in Saudi Arabia in particular. For example, Almulhim (2013) and Alenezi (2015) reported that saving time and effort was the only motivator of the pre-service teachers to use technology in their teaching, supporting the previous claim that they focus more on their own teaching than on the pupils' learning.

These views could be seen as naïve views about the role of technology and its pedagogical affordances in education as they focused only on the basic functions that technology provides, such as saving time and organising lessons. It has been argued that using this technology could help teachers and pupils in creating an enjoyable classroom environment which provides the interactive communication that enables all pupils to participate in the learning process (Wegerif & Dawes, 2004). As argued earlier in this chapter, the pre-service teachers who held these naïve views may have had less awareness of the pedagogical affordances (e.g. creating an interactive learning environment) that support learner-centred styles by supporting an active role for learners where pupils engage with these tools to build their own knowledge. Therefore, pedagogical guidance and support can be seen as a crucial issue at this stage of the pre-service teachers' preparation in order to help them to better translate their theoretical knowledge into practice. This can be seen clearly when looking at the TPACK questionnaire findings in Chapter Five, where the pre-service teachers seemed to 'perceive' their technological pedagogical knowledge (TPK) as high. However, and according to the classroom observation findings and the pre-service teachers' views about technology pedagogical affordances, they seemed to focus only on technological affordances when dealing with technology and attempted to employ it according to these affordances, such as organising lesson content and saving time.

These naïve views about the pedagogical affordances of technology seemed to lead them to use technology in the classroom focusing only on its function of facilitating information delivery, saving time and organising lesson teaching. This sheds light on the pre-service teachers' identity and their understanding of agency in the classroom. Although technological tools could provide many pedagogical affordances that would support different teaching strategies (e.g. using presentation technology to create an interactive learning environment), these tools seem to be appropriated by the pre-service teachers according to their own goals, and these are informed by their understanding of their role in the classroom where they deliver information to passive learners. Haenen et al. (2003, p.246) argue that pre-service teachers usually “plan to teach concepts in a straightforward matter-of-fact manner using a transmission model of teaching” as a result of their lack of practical experience. Therefore, as beginner practitioners, pre-service teachers need new psychological tools (e.g. pedagogical knowledge about teaching strategies) that help in shaping their identity as teachers (Hall, 2007). The acquisition of these new tools, according to Kozulin (2003), must be through intended guidance within their Zone of Proximal Development (ZPD).

8.3.1.2 The role of the relationships with others in informing the pre-service teachers’ pedagogical identity

Intentional guidance of pre-service teachers in their acquisition of new tools (or pedagogical development) is an important matter at the beginning of their teaching practice. This would help to avoid any negative influence of the context in building their identity, such as the school confirming their role as information deliverer through a traditional transmission strategy, as reported in the current study’s findings. Whipp, Eckman and Kieboom (2005, p.40) argue that “because sociocultural theory maintains that all learning is “assisted performance,” it follows that to learn new ways of teaching with technology, pre-service teachers need to constantly be in situations where they can access the guidance” that would allow them to develop in their ZPD.

Furthermore, pre-service teachers seem to have identity issues as a normal result of being novices. This is clear in the findings where they always focus on their role in the classroom as the centre of the process, not the pupils' learning. Because pre-service teachers' identity is socially constructed, they seem to attempt to create what Nias (1985) called a 'reference group' (e.g. peers, other teachers, university lecturers etc.) that is used by the pre-service teachers as a reality definer. Their learning during their early teaching practice seems to be mediated by the beliefs and behaviours of people in these reference groups. These are used by the pre-service teachers for self-evaluation and values definition (Nias, 1985). The findings showed frequent mention of peers and school members as models that pre-service teachers followed, especially when adopting a traditional transmission strategy of teaching or defining their role as teachers. As the influence of reference groups that the pre-service teachers might create is not always in the 'right' direction, any intended guidance they receive should take these reference groups into account by helping them to choose the appropriate reference group.

Not only more experienced others who might be used by the pre-service teachers as reference groups, but also pupils could be an influential reference group for them. As reported in Chapters Six and Seven, pre-service teachers claimed that they used technology as a tool to support the traditional transmission strategy of teaching because 'pupils asked them to do so'. According to Ajzen's Theory of Planned Behaviour (1991), 'normative belief' of the pre-service teachers about the desire of pupils to learn through this tool and this strategy might be used to confirm their choice of such a tool and teaching strategy. This confirms what Nias (1985) argues, that one of the most influential reference groups that informs the pre-service teachers' practice is pupils. As pre-service teachers spend more time in the classroom with their pupils, the latter significantly shape and influence the pre-service teachers' values and practice (Nias, 1985). However, pre-service teachers do not necessarily interpret the interest of the pupils in technology in an appropriate way. They might use the pupils' interest in technology to confirm their own choice. Pupils' interest in technology does not necessarily mean their interest in being passive receivers of information. They might want to learn actively by the help of technology which the pre-service teachers do not recognise (or do not want to).

From the above, I argue that the official guidance given to pre-service teachers during their teaching should take into account the social context where the teaching practice takes place. Providing pre-service teachers with feedback about their performance in the classroom, giving them direct instructions and suitable academic materials are not sufficient to guide them to build their professional identities. The stakeholders who have an official role in the pre-service teachers' practice do not always seem to be their definers of reality (Nias, 1985). Rather, multiple definitions of reality might be received by the pre-service teachers through the reference groups to which they may hold more loyalty than for their official guides (university tutor, head teacher and cooperating teacher). Understanding the social context of the school placement and the 'reference groups' that this context might provide can be seen as a key element for teacher educators in order to provide the appropriate guidance for the pre-service teachers.

8.3.2 Technology and affordances: another naïve view

The classroom observation and interview findings revealed that, among all the pre-service teachers who used technology in the classroom, visual modes of technology seemed to be the only choice. They thought that visualising concepts through technology was the appropriate representation of science and mathematics concepts in primary school, focusing on ‘drawing the pupils’ attention’ during the lessons. This issue has also been reported by other studies investigating pre-service teachers’ use of technology, both in Saudi Arabia and the wider global context (e.g. Almulhim, 2013; Enochsson, 2010). These studies found that the aim of using technology was only to bring ‘fun’ into the classroom and make the pupils interested in a specific subject. Given the traditional transmission strategy of teaching that the pre-service teachers in this study adopted, it seems that they believed in visual representation of concepts through technology as a good choice because of its appropriateness in presenting lecture style lessons, which was consistent with their teaching approach. This could be linked to what Ajzen (1991) termed as their ‘control belief’. They seemed to believe that they had good control over their ability to perform a traditional lesson through this use of this technology. It might be that being a ‘traditional’ teacher limited the choice of technologies that could be used in teaching and learning and limited their perception of the affordances of technology which could be used to perform an effective interactive lesson.

Moreover, the pre-service teachers’ views about visual modes of technology seemed to be more oriented to their technological affordances without taking its pedagogical affordances into account, as discussed in the previous section. For example they focused on the technological affordance of presenting a text that would save handwriting time, while they showed less awareness of the pedagogical affordance of creating an interactive learning environment. It seems that the pre-service teachers wanted to use this type of technology to provide better writing on the board, and more accurate shapes and objects in the case of mathematics for instance, as presented in Chapter Six. In this regard, Anthony and Walshaw (2009) pointed out that this type of technology with its dynamic features can provide a good interactive tool that allows pupils to construct their knowledge by taking an active role in their learning. They added that “with guidance from [pre-service] teachers, technology can support independent inquiry and shared knowledge building” (p.157). Therefore, I argue that pre-service teachers, especially in Saudi Arabia, need to be prepared in technology use in the light of the pedagogical affordances that enhance an interactive way of teaching and learning. This need was reported in the literature where the majority of Saudi pre-service and in-service teachers were found to be in need of pedagogical training related to technology affordances (Al-Faki & Khamis,2014; Alsulaimani, 2010; Mansour et al. 2014). This need has also been reported in many developed countries (e.g. Enochsson & Rizza, 2009; Enochsson, 2010; Nkhwalume & Liu, 2013).

Although visualisation of science and mathematics concepts through technology could provide learners with an effective tool for reasoning and problem solving (McLoughlin & Krakowski, 2001), the pre-service teachers in this study seemed to use it only to establish a channel of one-way communication, where they transferred knowledge to their passive learners. They seemed to assume that they were the active agents of change and the pupils ‘instruments’ of their agency. Moore (2008) argues that, when science teachers act as agents of change, they focus on establishing connection with their pupils through physical or psychological tools. However, visualisation through technology as a powerful cognitive tool seemed to have much more pedagogical potential and affordances than the pre-service teachers in this study recognised. It could support pupils to be active agents and offer them new ways to access information and manipulate it (Whalley, 1995).

Visualising science and mathematics concepts through technology is argued to be a powerful connector between the formal (and sometime abstract) knowledge and the pupils' cognition and reasoning process (Martin, 1990). However, it needs to be 'integrated' into the learning process not only 'implemented' as presentation tools that present information where pupils are required to make sense of this information (Whalley, 1995). Therefore, the presence of this type of visualising technology in the lesson does not necessarily mean that it is integrated into the learning process, as found in the current study. Rather, the pre-service teachers' recognition of this technology's affordances and their understanding of agency (being themselves the only agents of change in the classroom) might lead them to use it only as a presentation tool. This poor implementation (not integration) of visual technology among the pre-service teachers does not seem to provide a powerful teaching resource (Whalley, 1995). Therefore, there seems to be a need to prepare pre-service teachers to be able to develop new psychological tools and to develop pedagogical knowledge that allows them to guide their pupils' reasoning and problem solving. This is supported by Martin's (1990) argument that the use of visual technology should encourage pupils to understand phenomena and should foster their reasoning process. The key agent to achieve this aim is the pre-service teachers' themselves who need to be able to guide their pupils to achieve independent (at least to some extent) learning.

From the above discussion, it can be argued that pre-service teachers' identity, agency, beliefs, knowledge, and recognition of technology affordance play a major role in shaping their practice. All these aspects seem to shape and are shaped by the context of practice with all its social relationships. As was also presented in the study findings in Chapter Six, these aspects drove the pre-service teachers' decisions regarding the use of technology in the classroom. The following section discusses the views of technology users vs. non-users of technology in teaching and learning.

8.3.3 Technology affordances and perceived agency: users vs. non-users of technology

From the findings related to those who used technology in their teaching presented in Chapter Six, it was shown that they used it because the required technology that suited their teaching strategies was available in the school. The availability of visual modes of technology such as PowerPoint software that support the traditional transmission strategy of teaching (according to the participants' views) seemed to be an important factor that encouraged them to use technology. On the other hand, those who did not use technology indicated that technology equipment that would suit their teaching strategy, which was more learner-centred, was not available in the school (e.g. technologies that support individual learning and communication with pupils and their families). However, this view about the affordances of available technology (computers, projectors and presentation software) and their unsuitability for a learner-centred strategy seems to be another naïve view about the role of these technologies as they might be used to support interactive lessons.

Theoretically, I argue that both types of pre-service teachers (users and non-users of technology) seemed to have their teaching decisions and choices mediated by their identity and perceived agency in addition to other contextual factors. Therefore, their different identities and agency may have led them to adopt different practices regarding the use of technology. This arises from their different views about the same type of technology (visual technology) and the affordances of this technology in teaching and learning. Although they might be practising in the same context (same school in some cases or similar ones in other cases) and coming from the same university programme, it is normal for their identities to be different according to their specific individual beliefs and specific teaching situations, including the characteristics of their specific subject or classroom (subject matter is discussed in more detail later in this chapter).

From the study findings presented in Chapter Six, both types of pre-service teachers seemed to see themselves as agents of change but looking at agency from different angles. They both seemed to show strong control over teaching and learning processes. However, this control appeared differently among the two types of pre-service teachers; users and non-users of technology. For example, it can be argued that those who adopted a traditional transmission strategy of teaching (who were the users of technology) thought about themselves as the only active agents in the classroom delivering information to passive learners. Thus, they implemented technology to serve this aim, assuming that this control over teaching methods and pedagogy was the result of their active agency.

On the other hand, those who did not use technology and often tended to believe in a learner-centred strategy of teaching seemed to have a different pedagogical view although they believed in their active role as teachers and being active agents of change in the classroom. For example, a mathematics pre-service teacher from those who did not use technology held a different view to those of the first type about the value of technology in the current situation in the school. He believed that the technological tools needed to support the active role of the learners were not available in the school, thus making the assumption that presentation software and other visual technologies were ‘not’ suitable for his interactive strategy. He argued that in order to integrate technology into mathematics lessons he would need technologies appropriate for individual learning, such as a computer lab and communication software, as shown in Chapter Six. This view of the pre-service teachers about the nature of presentation technology is consistent with what Enochsson and Rizza (2009) found in their literature review about technology in schools in Europe, where they reported that the majority of available tools only supported the traditional transmission strategy of teaching and was limited to presentation technology. They argued that “the tools available at schools do not fit into a professional identity that aims at a student-centred way of teaching” (p.25). Although these technologies might be used to support interactive learning, Enochsson and Rizza (2009) indicated that, when there is only one computer in the classroom, which is consistent with the current study findings, the pre-service teachers can use it only as a presentation tool within a traditional transmission strategy. However, I argue that the pedagogical affordance of technology (even one computer and a projector) depends on the teachers’ practice and approach rather than on the technology itself. It also depends on the teachers’ thoughts about the nature of teaching and learning and how knowledge is built in a specific lesson.

Sociocultural theory assumes that both teaching and learning are social activities and learning starts at the social level before it is internalised by the learners (Vygotsky, 1978). Therefore, the available technological tools might fit with the learner-centred strategy of teaching, according to sociocultural thought, if pre-service teachers and learners share the process of teaching and learning interactively through the available visual technology. However, pre-service teachers who did not use technology due to the ‘lack’ of availability of technological tools to support learner-centred strategies, as they indicated, seemed to require technologies that support ‘individual’ learning, such as networking communication. This is clear in the study findings where the mathematics pre-service teacher who did not use technology thought he needed, for example, networking communication technology with learners and their families in order to integrate technology in his practice. His views about the nature of teaching and learning tended to adopt constructivist theory more than sociocultural thought. According to Hall (2007), unlike sociocultural theory, constructivist theory indicates that teaching is a social activity while learning is private. By adopting this notion, pre-service teachers who did not use technology seemed to see themselves as agents of change in the classroom whose role was to socially organise the process of teaching and provide opportunities to learners who, in turn, were expected to learn individually, thereby being active agents of change. The classroom observation findings confirm this argument, where the non-users were found to provide pupils with activities and give them the opportunity to learn individually rather than focusing on interactions during these activities as presented in Chapter Six.

From this difference between users and non-users of technology regarding the affordances of visual technology, one can argue that the users looked at technology as a ‘teaching tool’ while the non-users looked at it as an ‘individual learning tool’. Both types of pre-service teachers seemed to have an issue in the recognition of technology’s affordances and to have narrow views about its affordances. Each group seemed to assume the role of technology according to their perception of agency.

Looking at this issue from a different angle, I argue that the availability of a specific type of technology at school might also contribute to forming the pre-service teachers' pedagogy or at least drive them to specific teaching strategies. However, other contextual factors would probably make them look at this available technology from a different point of view and in turn adapt their affordances to fit with their complex identities that are contextually constructed. However, it is worth mentioning that, among the users and non-users of technology, science pre-service teachers were found to adopt technology to a greater extent than mathematics pre-service teachers, which raises a new variable (teaching subject) that seemed to contribute significantly to understanding the different practices adopted by the pre-service teachers. The issue of the teaching subject and technology is discussed separately later in this chapter.

In short, I initially thought that those who used technology regularly would tend to adopt a more learner-centred strategy than those who did not use it. This would be consistent with research that has reported that teachers with constructivist beliefs use technology more frequently (Ertmer, Ottenbreit-Leftwich & Tondeur, 2015). However, when I analysed the classroom observations and interviews I came to realise that the main reason for using technology was to improve the traditional transmission way of teaching (teacher-centred strategy) where the pre-service teachers were the only agents of change in the classroom and presented their own work to the pupils through visualising scientific concepts technologically.

In other words, the pre-service teachers who used technology regularly used it as a 'traditional' teaching tool, while those who did not use technology seemed to use non-technological tools as interactive learning tools. However, this inconsistency between the findings of this study and what is reported in the literature might be due to the difference in the context and the availability of a specific type of technology, which influences pre-service teachers' ability to employ technology in their teaching. Also, most of the literature highlighting this issue was conducted in developed countries where the context is different than that of the current study. One major difference reported in the literature is that in developing countries such as Saudi Arabia the focus has been on the provision of hardware and less attention has been given to the pedagogical aspects related to the use of technology (Kafyulilo, 2010). Therefore, the pedagogical knowledge (along with the other forms of TPACK) of the pre-service teachers might play a vital role in guiding them to the appropriate practice and in helping them to develop their professional identities properly.

8.3.4 Technology role and pedagogy: the matter of teaching subject

In this section, I discuss the findings related to the differences between the mathematics and science pre-service teachers' views about technology's role in the teaching and learning process and their pedagogical approach. It consists of two sub-sections; the replacement function of technology in science lessons and the additional function of technology in mathematics lessons.

The findings of the classroom observations and interviews presented in Chapter Six reveal that technology (particularly PowerPoint presentations, video and images) was the main tool that 'replaced' non-technological tools (such as real experiments, real models and samples) in the case of science pre-service teachers. However, it was an only ‘additional’ tool in the mathematics lessons beside non-technological tools (real shapes, counting and drawing tools, and pins and papers) that were seen by the mathematics pre-service teachers as more important for their lessons. It was also shown that all science pre-service teachers adopted a more teacher-centred strategy of teaching while mathematicians tended to adopt a learner-centred strategy. Is there any effect of the teaching subject on the pre-service teachers’ technology adoption and teaching strategy? And if so, how? This question is central to this section of the discussion.

One may argue that science and mathematics lessons can be looked at as different contexts, each with its associated nature, goals and practices according to the pre-service teachers’ normative beliefs about the contextual demands of each subject’s lessons. As the findings showed, the science and mathematics pre-service teachers thought about the role and affordances of the same type of technology differently; this tool was appropriated by the pre-service teachers in terms of the nature and demands of each subject. According to Kozulin (2003, p.29), “the same system of symbolic mediators may become associated with a different system of mediational practices”. Therefore, the specialised function of technology in either science or mathematics, according to the pre-service teachers, led to their different perceptions about the role of technology in teaching and learning and, in turn, to different practices. This issue is discussed in more depth in this section.

8.3.4.1 The ‘replacement’ function of technology in science lessons

It was reported in the findings that science pre-service teachers thought that the difficulty and complexity of some concepts in science required continuous use of technology (particularly presentations, video and images) to visualise these concepts. The findings also showed that technology had replaced all other non-technological tools that might be used in science lessons, such as real experiments. This ‘replacement’ was argued by science pre-service teachers to be due to possible practical issues that might face pre-service teachers when conducting real experiments. In addition, they also reported that they replaced real experiments with technology representations of these experiments to save time and effort. These two reasons behind the replacement of non-technological tools with technology were consistent with the wider literature findings about the use of technology by science teachers. For example, Hennessy et al. (2007), who conducted a study about the use of technology by science teachers in the UK, argued that “conducting the experiment in real time means that practical issues often supersede the teacher’s ‘intellectual input’, whereas once the simulation was running he spent less time helping children to understand what the task was and more time ‘discussing the learning points that the simulation was there to demonstrate” (p.6).

However, this claim among science pre-service teachers raises the issue of pedagogy and the role of learners during science lessons, especially in light of the traditional transmission strategy of teaching that science pre-service teachers particularly adopted, which was also consistent with the wider literature where science pre-service and in-service teachers were more likely to adopt teacher-centred than learner-centred strategies (e.g. Alenezi, 2015; Almulhim, 2013; Alshehri, 2012; Cady & Readen, 2007). Science pre-service teachers’ identity and their perceptions about agency in science lessons seemed to influence their interpretation of the science lesson’s demands and pedagogy adopted in relation to the use of technology. Their beliefs about their (and their students) roles during the science lessons seem to contribute significantly to shaping their practices in the classroom. Mansour (2010, p.514) argued that “beliefs influence people’s knowledge acquisition and interpretation, their task selection and organization, and their ways of understanding”. Thus, the science pre-service teachers’ normative beliefs about the contextual demands of science lessons can be seen as a significant contributor to the development of their identity and their understanding about agency. Science pre-service teachers’ identity might be associated with science as a subject where they feel “a personal sense of self as identifying with science” (Moore, 2008, p.590).

It seems that the science pre-service teachers believed that the role of learners during science lessons was to be ‘mentally’ active and the role of teachers was to capture their interest during the lesson and to ‘show’ them the context of scientific phenomena. Therefore, they found visual modes of technology such as presentations, images and video the ideal tools to be used in the science lessons. Martin (1990) argued that video was used in science lessons mainly to capture the learners’ interest and to contextualise scientific concepts which could provide them with the opportunity to ‘raise questions’ and to be ‘mentally active’. This may explain how the science pre-service teachers thought about agency in the science lessons where they were the active social producers and the learners were their products, apart from the minor control given to them to perform mental activities (internalising knowledge) in response to what the active agents (pre-service teachers) produced. Given the appropriateness of visual technology for this idea of agency and the traditional transmission strategy of teaching, as they claimed, this might explain why the science pre-service teachers replaced other traditional tools, such as real experiments, with technology, especially visual presentation technology.

Therefore, I argue that the science pre-service teachers saw their job as to transfer scientific knowledge and concepts to learners who did not have any active role in this transmission except for internalising this knowledge through mental activities. They sought tools that enabled them to establish connections (mainly one-directional) with their pupils, who were expected to receive and internalise knowledge. This view led them to focus on the technological affordances that video, for example, could offer in showing the experimental process without any consideration given to the role that learners could engage in during a real experiment which could offer them the opportunity to build their own knowledge and take control over their learning through a learner-centred strategy. This might be crucial in science lessons where learners need to engage in real world applications, as Cady and Rearden (2007) argued. However, the availability of the requirements for real experiments might be another issue that could hinder the use of this type of experiment. This issue was reported by this study participants where the lack of non-technological equipment needed for science lessons and experiments was reported. This lack of non-technological equipment was reported as a reason that increased the value of technology in science as an appropriate solution to the non-availability of other non-technological tools. Given that the available technology at school was mostly presentational, the science pre-service teachers might have had no choice but to adopt a teacher-centred strategy supported by technology as a result of the lack of other technological and non-technological tools that would enhance a learner-centred strategy. This argument was consistent with Enochsson and Rizza's (2009) finding that the majority of technological tools at schools only supported a traditional transmission pedagogy and was limited to presentations and evaluations. This issue supports what was argued earlier, that science pre-service teachers' beliefs about the nature of the science lesson and its demands would have an influence on their identity development and their understanding of agency in science lessons. Hence, contextual situations, such as the availability of a specific type of technology, might also be an influential factor that shapes the science pre-service teachers' identity and orients their pedagogical knowledge building as novice teachers.

In short, one can argue that the complexity of the teaching practice context, the intersections of its components, and the two-directional influences between its elements are all assumed to contribute to the complex process of the pre-service teachers' identity development and practice. However, the high dependence on technology among science pre-service teachers discussed in this section did not exist in the case of the mathematics pre-service teachers, who depended more on non-technological tools and regarded technology only as an additional tool for their lessons. The next section discusses this issue in more detail.

8.3.4.2 The 'additional' function of technology in mathematics lessons

Unlike the science pre-service teachers, mathematics pre-service teachers believed more in the importance of non-technological tools such as drawing and counting tools in mathematics lessons, in addition to technology. They also showed a strong belief that technology was important for mathematics to cover any lack of other non-technological tools. Therefore, they were less dependent on technology than their science colleagues who seemed to see technology as an 'alternative' to non-technological tools. Mathematics pre-service teachers indicated that technology could be useful for mathematics teaching but that it should be combined with the non-technological tools which should not be replaced by technology. They went further and indicated that non-technological tools were much more important than technology for mathematics teaching because pupils could practically engage and work by their hands with these tools. These findings are consistent with many other studies that have reported the limited use of technology by mathematics pre-service teachers compared to their science colleagues (e.g. Almulhim, 2013; Cady & Rearden, 2007; Enochsson & Rizza, 2009).

This pedagogical choice of mathematics pre-service teachers seems to be mediated by their beliefs about the mathematics lessons' nature and demands, where learners are assumed by the pre-service teachers to be active agents who should take control over their learning and perform tasks independently. Their identity as mathematics teachers might be developed by their belief that learning occurs in mathematics lessons through the learners' practice of problem solving strategies, assuming less control for teachers over the situation. Rather than being the only agent of change as shown in the science case, mathematicians tended to give more power to the other agents in the classroom, namely the learners. Mansour (2010) argued that teachers' pedagogical choices and decisions are mediated by their thoughts about the conditions of teaching a specific subject and the resources available to them. Therefore, considering the different perspectives about agency among science and mathematics pre-service teachers, and assuming science and mathematics lessons are two different situations, I may argue that pre-service teachers' identities are shaped differently according to their normative beliefs about the nature and demands of each subject.

Although the use of technology is argued in the literature to be an essential tool when teaching and learning mathematics and is considered to be a good provider of new opportunities for teachers and students (Anthony & Walshaw, 2009; Drijvers, 2012; NCTM, 2008), Saudi mathematics pre-service teachers recorded very low use of technology and tended to adopt non-technological tools as shown in the findings of this study, which are also consistent with other studies conducted in Saudi Arabia (e.g. Alotaibi, 2011). However, some studies (e.g. Alenezi, 2015) reported some basic use of technology among mathematics teachers, namely for presenting shapes. Although many visual presentation technologies are available at schools, mathematics pre-service teachers did not seem to recognise their affordances in supporting a learner-centred strategy of teaching. Wertsch (1991, cited in Lim, 2003, p.412) argued that "the power of mediational tools in organizing activities is often not consciously recognized by those who use them, which contributes to the belief that cultural tools are the product of natural or necessary factors rather than of concrete sociocultural factors". Accordingly, the affordances and opportunities that the available technology could offer the learner-centred strategy (as well as other teaching strategies) were not necessarily recognised by the pre-service teachers. Therefore, the technological pedagogical content knowledge (TPACK) associated with mathematics teaching seemed to play a major role in forming their control beliefs about the affordances of these technologies and their use in mathematics lessons. Although they perceived that they had high level of this form of knowledge, as presented in Chapter Five, they did not in fact seem to be well prepared pedagogically, as their recognition seemed to be limited to the technological affordances that served lecture style teaching. Thus, they adopted non-technological tools rather than technology, showing a strong control belief about their ability to use these non-technological tools in performing learner-centred mathematics lessons.

Given the lack of technology that could support a learner-centred strategy of teaching as claimed by the mathematics pre-service teachers, and supported by Enochsson and Rizza (2009), it can be argued that mathematics pre-service teachers, as presented in Chapter Six, used non-technological tools to provide pupils with the opportunity to take control over their learning. They seemed also to use non-technological tools as mediators that allowed engagement with the real world, which is consistent with the findings of Cady and Rearden (2007) who argued that “mathematics and science teachers should use real world applications in the classroom” (p.241).

From the mathematics pre-service teachers’ statements, they adopted more learner-centred instruction than their science colleagues, who did not give their pupils enough control over their learning. Therefore, one may argue that the professional identities of science and mathematics pre-service teachers might develop and be shaped differently according to their perceptions about the nature and demands of science and mathematics lessons. While science pre-service teachers seemed to perceive their powerful position and strong agency over the science lesson, mathematicians shared their power with their learners, who were also active agents of change during the mathematics lesson. This can be seen clearly when they addressed the importance of the non-technological tools used by the pupils themselves to learn deeply. In contrast, science pre-service teachers (who were the only active agents of change) tended to adopt a visual mode of technology in teacher-centred lessons, where pupils (who were instruments of the more powerful agent) were sitting and watching these visual illustrations of science topics. These findings are consistent with Cady and Rearden's (2007) findings, who found that mathematics lessons were more learner-centred than science lessons, which were more teacher-centred.

In short, one can argue that subject area seems to be an important factor in determining the nature of the use of technology and teaching strategy being practised in the classroom according to the demands of each subject. Although this may be claimed, both science and mathematics pre-service teachers seemed to lack subject-specific recognition of technology's affordances and its mediational power in teaching their subjects. From the above, the pre-service teachers' TPACK and its sub-forms of knowledge (TK, CK, PK, PCK, TCK, and TPK) appear as crucial elements that might inform and shape their practice significantly and contribute to shaping their professional identities and their relationships with the others in the practice context. Special attention might need to be given to the specialised cognition of the pre-service teachers about the nature of their teaching subject and its demands from a pedagogical point of view. This could be through reviewing the university courses to meet this demand and through guiding them effectively during their practice at school with strong consideration given to this area of knowledge and cognition. It is also important to consider the actual context where the pre-service teachers practice teaching, taking into account its characteristics, culture and available resources and tools. Pre-service teachers in this study did not seem to be introduced to their school context when they started their teaching, rather, they seemed to be guided according to 'universal' or 'national' standards isolated from the actual context of their particular practice school. Therefore, I claim that the specific school context needs to be taken into account by contextualising the pre-service teachers' practice so they can recognise the actual demands of the lessons and put theory into practice properly.

8.3.5 Contextual dimensions of beliefs and identity development

The findings in Chapter Six showed that some participants had developed beliefs related to the use of technology and its pedagogy during their university study prior to their teaching practice at school, while others developed these beliefs after engaging in practice. In some cases, the participants had already come from the university with a strong belief in the importance of technology and had planned previously to integrate it into their teaching when they engaged in the school placement. This division of pre-service teachers might indicate two different identities among them at the beginning of teaching practice at school. According to the their recognition of their role at this stage, either as ' still students' or 'already teachers', pre-service teachers' identities seem to guide their learning, practice and relationships with others. Au (1990) argues that developing practical teaching knowledge starts when pre-service teachers recognise pedagogical issues. This recognition might be perceived in an early stage when they are still studying at the university. Therefore, pre-service teachers in this category seem to move from the university courses into teaching practice with pre-determined strategies and perceived practical knowledge. In contrast, other pre-service teachers might not see themselves as teachers yet, and move to the practice with a 'still students' perceived identity. The pre-service teachers in this category seem to start appropriating pedagogical practices and setting goals after they recognise issues during lessons. However, I am not claiming a fixed boundary between the two categories of pre-service teachers, rather, development of beliefs and identities can be seen as a continuous process during all stages of teacher education and beyond. By this division of pre-service teachers into two categories, one may argue that some of them develop a strong teacher identity earlier than others according to their perceived knowledge and normative beliefs.

In terms of sociocultural theory, those who come from the university with a developed teacher identity seem to see the university context as the social context where they have socially learned to teach with technology and have already internalised psychological functions or tools (Kozulin, 2003; Vygotsky, 1978) (leading to professional identity development) and see the school context as a field where they act as professionals and perform their strong agency. In other words, pre-service teachers' identity building (as an activity) might start as interaction between themselves and more experienced others such as lecturers (who can be seen as an influential reference group) which they then internalise as their own psychological function (professional identity with all its characteristics). On the other hand, the other category of pre-service teachers might look at teaching practice as a scaffolding mediator that confirms their understanding and builds their practical knowledge. The school context seems to be the context for social interactions and internalisation of psychological functions for these pre-service teachers. This type of pre-service teacher can be seen as an active learner in their zone of proximal development. Their colleagues in the other category, in contrast, might tend to negotiate with individuals and culture at school in order to confirm their pre-determined pedagogical choices previously developed by influential 'reference groups' or individuals outside the school context such as university lecturers.

For those who developed teacher identity and beliefs earlier during the university study, it was found that they were influenced by their lecturers' use of technology and the pedagogical approaches associated with this use. Their lecturers at university seem to be a powerful reference group that mediated their learning and identity development. However, this influence did not seem to have been intended by lecturers, rather, pre-service teachers in this category seemed to adopt a lecture style of teaching and appropriated it for the primary school level. In this case, pre-service teachers might perform what Bandura (1977) called ‘observational learning’ or ‘learning through imitation’. When the pre-service teachers pay attention to their lecturers’ behaviour (the use of technology with traditional transmission strategy), they seem to imitate or copy the observed teaching style regardless of whether this style is appropriate for the new context (primary school) (McLeod, 2016).

The use of presentation software to support a traditional mode of teaching (lecture style) seemed to attract the pre-service teachers and influence their use of technology at school, imitating the same strategies to teach primary school pupils. This sheds light on the vital role that lecturer modelling (as an effective learning mediator and powerful social agency) plays in forming the pre-service teachers’ pedagogical identity and informing their practice later. This claim is supported by a large body of literature where lecturers’ modelling of the use of technology was seen as an influential element in teacher education. For example, Meredith (2011) argued that university lecturers “need to be aware of the need to model good uses of ICT in their lectures and practical sessions” (p.17). However, the issue of poor modelling of technology use by lecturers was found to negatively influence the pre-service teachers’ practice, as widely reported in the literature (e.g. Brun & Hinostroza, 2014; Meredith, 2011). In addition to intentional modelling of technology use, lecturers’ actual practice (unintended modelling) needs to consider this issue and lecturers need to help pre-service teachers to use technology appropriately in the light of the context and its characteristics. Lecturers need to be aware that pre-service teachers are active information processors who might imitate the university teaching style and apply it later in primary school. They need to realise the model function of their normal teaching in order to avoid any negative influence of the pre-service teachers' observational learning.

Some studies, such as Brun and Hinostroza (2014), found that many lecturers teach their students the use of presentation software in a traditional transmission way of teaching, whereas only a minority model the use of other technology uses that support other teaching strategies. In Burn and Hinostroza's (2014) study, the participants argued that PowerPoint presentations were the only technology they dealt with. Even though lecturers might use technology purely for the purpose of their lectures, pre-service teachers seem to make it their own mediator and put so much in the agenda of the lecture through their observational learning. Pre-service teachers as students at the university might appropriate lecturers' practice and organise and evaluate knowledge they build through observing their lecturers acting as agents who have social control over the situation (Riseborough, 1985). Therefore, I argue that, in order to achieve successful and effective use of technology, the pre-service teachers' pedagogical beliefs and their pedagogical knowledge related to technology need to be given more consideration through modelling good use of technology during lectures which seem to be a powerful social mediator of their learning and professional identity development.

In addition to the pre-service teachers who actually used technology in their teaching, as discussed above, it was also found that those who did not use technology at all at school did believe in its importance in education. Confirming the powerful mediational influence of lecturers' practice as a reference group (or individuals) in forming their pedagogical identities, as claimed above, these pre-service teachers indicated (as presented in Chapter Six and Seven) that they were influenced by their lecturers' practice in using technology for an interactive learner-centred strategy during lectures. However, they did not use it at school because they did not find technological tools that supported their more learner-centred teaching strategy. This suggests that these pre-service teachers had developed their belief (about the demands of teaching and learning) and internalised psychological tools that believed in a specific teaching strategy during their university study, in theory; however, when they came to school, they did not find the required tools or environment for integrating technology, showing a weak control belief (about their power to perform a specific activity) over the situation. Therefore, they retained the belief about technology that they had developed previously at university but avoided adopting technology due to the lack of readiness of the school.

According to the sociocultural model of embedded belief systems (Jones and Carter, 2007), those pre-service teachers showed a conflict in their belief system between their attitude towards instruction, where they believed in the importance of integrating technology into practice, and their attitude towards implementing this type of instruction as a contextual issue, due to an environmental constraint where the school setting did not support this type of instruction and the necessary tools (technology equipment) were not available. This environmental constraint (lack of equipment appropriate for learner-centred strategy) was a challenge that faced the pre-service teachers and prevented their adoption of technology. According to Jones and Carter (2007, p.1076), in the belief system, "if one attitude is positive and the other is negative, the relative strengths of attitudes will determine whether there is motivation to undertake the task".

On the other hand, for those who developed their beliefs related to the use of technology in the classroom after they engaged in teaching practice, they stated that engaging in teaching practice after they came to school had persuaded them of the importance of technology use and its role in education. This suggests that pre-service teachers might not believe in what they learn theoretically at university (internalising psychological functions) until they engage in teaching experience. Therefore, teaching practice at school might be seen as a 'learning' not only a 'training' context for the pre-service teachers. At the school they perform the second level of learning (according to sociocultural theory) which is internalisation of psychological function following the first level of learning (social level) that occurred previously at the university. This argument is consistent with what is reported in the wider literature where teaching practice was reported to be an important 'learning' environment that might provide pre-service teachers with new theoretical thoughts and concepts that they did not previously learn, or at least did not consider, at university. For example, Enochsson (2010) found that some pre-service teachers thought during their university study that they would not use technology with their teaching later at schools. Nevertheless, when they engaged in teaching practice they changed their pedagogical ideas and decided to use it. This change in pedagogical ideas and beliefs about technology's role in education can be seen as 'learning processes' occurring in the school context. This issue sheds light on the learning opportunities that should be provided by the partnership between school and university to the pre-service teachers. This requires both institutions to work together and analyse the pre-service teachers' needs and the aspects that could help the pre-service teachers to learn properly at school, not simply to practise what they have already learned at university. A good combination of learning at university and learning at school should contribute to preparing good teachers and provide them with more opportunities to put their theoretical concepts into practice in a more coherent and comprehensive way.

8.3.6 Challenges and perceived power within the practice context

As shown in the findings from the classroom observations and interviews in Chapter Six, several technical issues were seen by the pre-service teachers to be challenges that negatively influenced their use of technology among both users and non-users of technology in the classroom. Some of them were found to be ‘too’ dependent on technology to the extent that they postponed lessons when they faced technical issues. For example, one of the science pre-service teachers, as shown in Chapter Six, reported that when the computer had broken down or the internet connection was lost he would postpone the lesson until the problem was solved. Also, the classroom observation findings showed that one of the science pre-service teachers left the classroom in the middle of the lesson to ask his colleague to solve a problem with the computer that affected the projector. In addition, one of the mathematics pre-service teachers who seemed to be less skilled in technology reported the difficulty of operating some types of technology as a technical challenge. For example, he found it difficult to connect devices and run the PowerPoint presentations without the help of the cooperating teacher who usually prepared them before the lesson. On the other hand, those who did not use technology seemed to be more affected by challenges related to technology. For example, the mathematics pre-service teacher who did not use technology claimed that the available technology at school did not support a learner-centred strategy and the whole school context needed to be prepared for technology use. Therefore, he did not use technology and used traditional tools instead. However, those who used technology seemed to overcome these challenges by seeking solutions beyond the classroom boundaries and accessing resources from the wider context. Those who did not use technology, on the other hand, seemed to see these challenges as obstacles that they could not overcome, which led them to adapt their teaching, acting only within the limitations of the classroom in which they had agency.

The issue of dealing differently with the challenges among pre-service teachers reported above highlights the different agency forms that they assumed and the power of change they perceived. Their different decisions in response to the challenges they faced (as shown in the previous paragraph) might be mediated by their perceived agency, which was either limited to the classroom level or went wider to include the whole practice context. This difference in the perceived power of change among pre-service teachers could be affected by their awareness and perceptions about their role and position in the school and the strength of their professional identity. Mansour et al. (2014, p.21) argued that “teachers’ learning and enactment of their learning is affected by the teachers’ interpretations and awareness of the demands and challenges of their educational context”. For those who acted beyond the classroom level to overcome challenges, they seemed to perceive strong agency within the context which led them to establish connections with the others in the school community in order to overcome obstacles. According to sociocultural principles, pre-service teachers’ practice can be seen as an assisted performance which requires accessing guidance (Whipp et al., 2005). Therefore, those who showed strong agency succeeded in accessing guidance from more experienced others in the context and employed this guidance to facilitate their pedagogical choices. This type of pre-service teacher seemed to make the most of their Zone of Proximal Development.

On the other hand, the pre-service teachers who did not use technology seemed to perceive 'weaker' agency, limited to the classroom level. They seemed to feel that they had control only over their classroom and they acted according to this perception, adapting their pedagogical choices according to this limited power. This type of pre-service teacher seemed to assume that the power of change outside the classroom was too radical and was beyond their actual practice context which seemed to be limited to the classroom level. Being possessors of relatively weak agency, these pre-service teachers seem to have limited their own Zone of Proximal Development, which might lead to missing significant learning opportunities. According to Whipp et al. (2005), pre-service teachers should access constant guidance from more experienced others within the context in order to make the most of their Zone of Proximal Development. They added that "without a sharp division between expert and novices, all are able to assist others in their own areas of competency but also find assistance in their own 'zones of proximal development'" (p.40). Therefore, pre-service teachers need to shift from a culture of isolation to the collaboration level. Teacher education programmes need to consider preparing pre-service teachers to work on wider social tasks, engage in the community and interact with the others in order to be able to overcome any potential challenges or obstacles that might face them during their teaching practice. Teacher educators should consider the fact that pre-service teachers might develop different shapes of identity and perceive different agency when they move to practice (Moore, 2008) which could significantly shape their pedagogical perspectives. They should guide pre-service teachers to learn within their Zone of Proximal Development and guide them to gain new ‘psychological’ learning tools that enable them to make the most of their ZPD.

In this regard, the poor organisation of the partnership between university and school was widely reported by the participants and seen as an issue that could negatively influence the pre-service teachers’ acquisition of knowledge and of the psychological tools that mediate this acquisition. As presented in Chapter Seven, some school communities regarded the pre-service teachers as only assistants of the school teachers and their job was only to support the school staff according to the school policy, bearing no relation to the university programmes or to the aims and objectives of the partnership between university and school. This view about pre-service teachers (as assistants of the school teachers) seems to be a significant contributor to the pre-service teachers’ identity development and their perceptions about agency. As discussed above, when pre-service teachers perceive this as their role in the school, they might not see the actual wide boarders of their Zone of Proximal Development within the practice context and limit their learning activities to the classroom level.

8.4 Summary of the chapter

In this chapter, I have presented two main aspects: firstly, brief responses to the research questions from the study findings presented in the previous chapters; secondly, the meanings of the main findings emerging from the quantitative and qualitative data analysis in relation to the wider literature, interpreted through the lens of sociocultural theory.

9 Conclusion

9.1 Introduction

This chapter concludes the thesis by presenting an overview of the study and its main findings. It discusses the study's contribution to knowledge, including theoretical and practical contributions. It also discusses the study's limitations and presents justifications for these limitations. Implications that are suggested by this study are also presented in this chapter including implications for policy makers, teacher educators and school staff who are engaged in pre-service teachers' school placement. I conclude the chapter with recommendations for further research and concluding remarks.

9.2 Overview of the study and its findings

The study aimed to explore the Saudi Arabian science and mathematics pre-service teachers' perceptions and practices related to the integration of technology in the primary school classrooms and to identify the key factors that influence their practice with regard to the use of technology in the classroom. The relationships between their identity development, their understanding of agency, and their recognition of technology affordances were examined in depth based on the study's theoretical framework (sociocultural theory), to provide insights into the pre-service teachers' practices and perceptions related to technology. To achieve these aims, the study sought to answer the following research questions:

- What is the science and mathematics pre-service teachers' perceived technological pedagogical content knowledge (TPACK)?

- What is the relationship between the science and mathematics pre-service teachers' perceptions and practices of the integration of technology in the classroom?
- What is the relationship between the science and mathematics pre-service teachers' experience with technology and their practices of the integration of ICT in the classroom?
- How does the school setting influence the pre-service teachers' perceptions and practices of the integration of technology in the classroom?
- How does the university setting influence the pre-service teachers' perceptions and practices of the integration of technology in the classroom?
- How does the partnership setting influence the pre-service teachers' perceptions and practices of the integration of technology in the classroom?

Personal (e.g. perceptions and experiences), professional and contextual factors (e.g. relationships with others) were explored to draw a complete picture of the issue under investigation. To answer the research questions, I used the TPACK questionnaire, classroom observations and interviews to collect both quantitative and qualitative data about the relationship between the science and mathematics pre-service teachers' perceptions and practices related to the integration of technology in the classroom and the influence of the practice context on their integration of technology. Findings emerging from these data were presented earlier in Chapters Five, Six and Seven.

Pre-service teachers' perceived Technological Pedagogical Content Knowledge (TPACK) was examined through quantitative TPACK questionnaire. The aim of this quantitative instrument was to provide background information about the pre-service teachers' different forms of knowledge and to provide a better understanding of, and justified foundation for, the qualitative data from the classroom observations and interviews. On the basis of the findings, it can be argued that having information about how the pre-service teachers perceived their knowledge related to the use of technology has helped in interpreting some aspects of their perceptions and practices that emerged later from the observation and interview data.

The qualitative findings from the classroom observations and interviews identified two different categories of pre-service teacher: users and non-users of technology. Interestingly, pre-service teachers who used technology were found to adopt more traditional transmission strategies of teaching. They perceived strong agency assuming that their role was to transfer knowledge to passive learners through visual technological tools. In contrast, those who did not use technology seemed to assume a more active role from the pupils they were teaching. Therefore, non-users of technology thought that visual technology such as PowerPoint presentations were not appropriate tools for learner-centred strategies of teaching and they showed less awareness about the affordances that this type of technology could provide. Accessing guidance from university tutors and school staff during teaching practice was found to be a significant element that could allow pre-service teachers to learn properly within their zone of proximal development and contribute considerably to their pedagogical identity development and their understanding of agency in the classroom. Moreover, their teaching subject (science and mathematics) and their perceptions about it were found to be an important factor in shaping the pre-service teachers' identity and practice.

The findings also demonstrated that the pre-service teachers' pedagogical beliefs and their perceptions of the role of technology might be developed either during their university study (e.g. through imitating their lecturers' practice) or after they engage in teaching practice at school. Finally, some challenges were reported by the pre-service teachers to be obstacles that negatively affected their adoption of technology including, technical, time and personal challenges.

In order to discuss these findings and examine their meaning theoretically, I adopted multiple theoretical frameworks to enable a focus on different aspects of the science and mathematics pre-service teachers' perceptions and practices regarding technology adoption and the relationships between these two domains. The TPACK framework was used to understand the pre-service teachers' perceived knowledge related to the use of technology in the classroom and to provide a foundation for the qualitative findings' interpretation. I also used the affordance theory to gain insights into the pre-service teachers' recognition of what technology can offer them to improve teaching and learning processes. Moreover, the Theory of Planned Behaviour was used to understand different forms of their beliefs and their relationships with the pre-service teachers' practice. Identity and agency concepts were used to understand how pre-service teachers developed relationships with the others within the context and to understand the perceived control the pre-service teachers had over their practice which could shape their social relationships. However, it is worth mentioning that the use of identity and agency concepts in this study did not focus on the individual level, but rather I used these domains to better understand the social relationships between individuals within the teaching practice context. All these frameworks and concepts were used under the umbrella of sociocultural theory and informed and oriented by its principles to achieve the aims of the study.

9.3 Contributions to knowledge

This study was conducted to explore the Saudi Arabian science and mathematics pre-service teachers' perceptions and practices related to the integration of technology in the classroom. According to the study objectives presented earlier, and in the light of what has been reported in the study findings and discussion of these findings, I argue that the study has met the goal of providing significant contributions to theory and practice. These contributions can be implemented by teacher educators, universities, schools and researchers in order to improve teacher education programmes and the partnership between universities and schools in relation to the use of technology in the classroom by the pre-service teachers. It gives useful insights into their identity and agency development, their pedagogical knowledge development and their beliefs construction. These contributions are discussed in more detail in the following sub-sections.

9.3.1 Theoretical contribution

This study, based on its theoretical framework and findings, may contribute theoretically to the field of teacher education and inform teacher education programmes in relation to the use of technology by pre-service teachers. According to the study findings, pre-service teachers' identity development must be considered carefully during all the stages of teacher education. Interestingly, pre-service teachers' identity and their perceptions about agency in the classroom lead to a specific recognition of the role of technology and its affordances in the classroom. According to how they see the role of the teacher and the learner and the relationship between them, pre-service teachers then select an appropriate role for technology and focus on specific affordances that technology offers. Pre-service teachers' decisions to use (or not to use) technology does not seem to be related to technological skills, rather, their pedagogical choices are mediated by their identity and their perceived agency during the teaching and learning process. They might have identity issues at the beginning of their practice as a normal result of being novices. It was found that they focus more on their own teaching rather than the pupils' learning which limited their recognition of the affordances of technology associated with an interactive learner-centred strategy. They seem to use technology to improve their own teaching only, which leads to their adoption of a more teacher-centred strategy of teaching.

At the transition stage (moving from the university courses to teaching practice) pre-service teachers hold the psychological tools (e.g. perceptions and beliefs) they develop during the university study. These tools are not always the appropriate tools for practice and its needs as they develop them through both intended and unintended activities (imitating the lecturers' own practice) at the university. Therefore, preparing them to be ready to gain new psychological tools and providing them with opportunities to access the 'assisted performance' during practice is a major concern that needs to be considered by teacher educators.

Moreover, pre-service teachers, as novices, usually create 'reference groups' (e.g. peers, teachers, lecturers) within the practice context or from outside. These groups are used by the pre-service teachers for self-evaluation and to define their values. As the influence of these groups is not always in the 'right' direction, pre-service teachers sometimes use them to confirm inappropriate practice and mediate 'negative' learning. Therefore, teacher educators need to widen their tasks to include effective guidance through the practice context to help them to create appropriate reference groups.

Furthermore, some pre-service teachers develop beliefs associated with the use of technology during their university study, while others develop these beliefs after engaging in practice. Those who come from the university with a professional teacher identity see the university context as the social context where they have learned to teach through interaction with others and have already internalised psychological functions and see the school context as a field where they act as professionals and perform their strong agency. The other category (those who come to school with a student identity) look at practice as a scaffolding mediator that confirms their understanding and builds their practical knowledge. The school context is the context of social interactions and internalisation of psychological functions for these pre-service teachers where they learn to teach through interaction with others at school and then internalise this knowledge as the second level of learning, according to sociocultural theory. This suggests that some pre-service teachers do not believe in what they have learned theoretically at university (internalising psychological functions) until they engage in teaching experience. Therefore, teaching practice at school is seen as a 'learning', not only a 'training', context for the pre-service teachers where they perform the second level of learning, which is internalising psychological functions following the first level of learning (social level) that have occurred previously at the university.

9.3.2 Practical contribution

The study may also contribute to the field of teacher education by informing teacher educators about the nature of the practical knowledge that pre-service teachers need to acquire in order to develop appropriate perceptions about technology and the specialised knowledge for using technology in their own teaching subject (e.g. science and mathematics). Although the questionnaire findings showed that pre-service teachers perceived their TPACK (and its sub-forms) as at a high level, the qualitative findings show that they have limited knowledge about technology's applications and its affordances for interactive learner-centred strategies. This suggests that they perceive using technology with the traditional teacher-centred strategy of teaching as the right practice (associated with the good knowledge) because they were taught with this strategy at the university, which led them to evaluate their knowledge according to their own frame of reference which they created at the university. They need to engage more with school practice in order to better assess their knowledge associated with technology use in the classroom. Connecting the pre-service teachers with the practice context at school from an early stage of their study would provide them with good practical perceptions and knowledge that would help them to appropriate pedagogical aspects related to technology use in the classroom.

Furthermore, users of technology tended to adopt a more traditional transmission strategy of teaching, while those who did not use technology adopted a learner-centred strategy. Each group thus seemed to appropriate the technology role and affordances according to their pedagogical choices. As such, the non-users chose not to use technology as they thought the available technology (presentations) was inappropriate for the learner-centred teaching strategy they wanted to apply. They viewed technology as an individual learning tool, which, according to some participants, requires a 'device per child'. In contrast, the technology users looked at technology as a teaching tool; one that supported them to deliver the content in their classrooms. Therefore, the pedagogical knowledge of the pre-service teachers needs to be considered by teacher educators who should guide them towards the appropriate affordances of technology according to the pedagogical needs of the primary school level and their teaching subject.

Teaching subject was found to be an important factor in determining teaching strategy and perceptions about the role and affordances of technology. Science pre-service teachers were found to be more traditional, using technology as a tool to transfer knowledge to learners. In contrast, mathematicians tended to adopt a more learner-centred strategy giving learners more control over their learning. With regard to the use of technology, science pre-service teachers used presentation technology as the only teaching tool while mathematicians tended to be non-users of technology. The mathematicians however, did use non-technological tools as interactive tools. However, both science and mathematics pre-service teachers seemed to lack specialised understanding of technology affordances that could serve their teaching subject. Therefore, specialised knowledge (pedagogical knowledge related to a specific teaching subject) associated with the use of technology needs to be identified during teacher education programmes and pre-service teachers need to acquire the technological pedagogical content knowledge (TPACK) that would allow them to integrate technology in their lessons effectively.

Another important issue reported in this study was the availability of a specific type of technology in schools (presentation technology) which was found to be an important factor influencing the pre-service teachers' perceptions and practices associated with the use of technology in the classroom. The availability of a specific type of technology could contribute to forming the pre-service teachers' pedagogy or at least drive them to specific teaching strategies. Therefore, practice schools and their facilities and resources need to be considered by teacher educators in order to provide pre-service teachers with the appropriate opportunities to learn properly.

9.4 Limitations of the study

As described earlier in this chapter, this study has met the goal of providing significant contributions to theory and practice in the field of teacher education in relation to the use of technology by pre-service teachers in the classroom. However, as a result of being a postgraduate researcher with limited time and resources, this study has several limitations. First of all, the study was conducted based on the interpretive paradigm using a case study approach, which makes the generalisability of its findings limited. Although interpretive research does not seek generalisation (Silverman, 2010; Wellington, 2000), it is claimed that this kind of research strategy can allow some amount of generalisation from the instance to a wider class (Cohen et al., 2010). In this study, as discussed earlier in the methodology chapter, the present type of case study can be seen as an instrumental case study because it provides insights into science and mathematics pre-service teachers' perceptions and practices related to the use of technology in the classroom across the whole country of Saudi Arabia. These insights could possibly be extended to the wider context of the Arab world due to the similarities between educational policies and systems, teacher education systems and cultural backgrounds within these contexts. However, having more time and access to other teacher education programmes in other universities would provide a more comprehensive picture about the pre-service teachers' perceptions and practices related to the integration of technology in the classroom and would include a wider range of contextual factors that might influence their use of technology.

Moreover, the study adopted sociocultural theory as the theoretical framework of the study. The adoption of theoretical frameworks is argued to strictly guide the process of the study and limit its focus to within the theory's scope, which could negatively affect the richness of its data description in general (Braun & Clarke, 2006, p.83). This could occur, for example, when the themes are pre-determined and deductively based on the theoretical framework principles. However, in order to both avoid the limitations of theoretical thematic analysis and take the advantages of theory as a powerful tool to conduct research, open thematic analysis was conducted to code data inductively without fitting it into pre-determined frame. However, the principles of sociocultural theory were considered and 'kept in mind' during the data analysis process, which could provide the opportunity for the data to speak about itself and keep the study in the chosen theoretical direction at the same time. Theoretical principles were applied more explicitly and intensively in the discussion chapter in order to interpret the findings which emerged from the open thematic analysis.

Furthermore, the trustworthiness of the study and its findings was an important concern during all the stages of the study. Although I employed several techniques to ensure its quality, such as peer review of the data and interpretation, discussion with my supervisors, presenting in conferences and getting feedback from academic audiences, the study is still formed from an individual researcher's view as a normal result of being an interpretive study, which can be seen as a limitation.

In addition, the study relies mainly on the perspectives of the pre-service teachers, university tutors and head teachers. This issue can be seen as another limitation as it would be valuable if other stakeholders were involved, such as university lecturers, cooperating teachers at schools and administrators. Involving more stakeholders would probably provide more insights into the use of technology by the pre-service teachers and their perceptions about it. However, this was difficult to achieve due to the limited time and resources.

The subject areas of the sample were another limitation of this study. The study focused on science and mathematics pre-service teachers' perceptions and practices related to the use of technology. This was because these two subjects were found to be more associated with technology use than other subjects as shown in the literature review chapter. Also, these two subjects are my area of interest, of which I have experience of teaching in primary school and of supervising pre-service teachers at the University of Hail. However, including more subjects, such as languages, history and literacy, in the study focus would have provided a wider view about the pre-service teachers' perceptions and practices related to technology and more sociocultural factors would possibly have emerged from the data.

Another limitation was the relatively small sample size. While the whole population of science and mathematics pre-service teachers at the University of Hail was 53 during the academic year 2013, only seven of them agreed to participate in the study. The others were either non-users of technology or unwilling to participate in the qualitative phase of the study. Therefore, I only had seven pre-service teachers, four university tutors, and four head teachers as the sample. Having a larger number of participants would have provided me with the opportunity to gain more insights about the issue under investigation and more factors would possibly have emerged from the findings.

In addition, the gender of the sample was another limitation that faced this study. As the educational system in Saudi Arabia in all its stages strictly segregates schools and academic institutions based on the students' gender, it was impossible to extend my study focus to include female pre-service teachers especially with the current study design that employed classroom observation as a tool of data collection. However, it would have been very valuable if I could have extended my study focus to include female pre-service teachers as this would perhaps have enriched the data and revealed important sociocultural factors related to gender.

Finally, the school level on which this study focused, which was primary school, was another limitation that needs to be reported. Including other school levels (middle and secondary) in the focus of the study would have enriched it and increased the value of its findings by revealing more sociocultural factors and variables related to the students' age and nature of the curriculum. However, this was difficult as it would require including more subject areas of the pre-service teachers as a result of the differences between the primary and other school levels' curriculum.

9.5 Implications

The findings of the study provide many implications for policy makers, teacher educators, pre-service teachers, head teachers, and cooperating teachers. These implications are reported in the following sub-sections.

9.5.1 Implications for policy makers

Teacher education seems to be given priority by policy makers who put significant effort into improving this field. However, the 'quantity' concept seems to be the main concern in the agenda, more so than the 'quality' (Kafyulilo, 2010). For example, most of the government's effort was directed to the provision of resources and equipment that were supported by the Ministry of Education's huge budget. Pedagogical aspects did not seem to have sufficient attention in the agenda as the students in the colleges of education are provided with technical skills which are removed from their pedagogical applications. Filling the students' minds with knowledge that is sometimes not very related to the schools' actual practice is a problematic characteristic of the teacher education programmes. Therefore, improving teacher education programmes requires connecting them with the actual educational practices at schools where pedagogy and developing teachers' identity should be given the priority.

Moreover, the management of the partnership between university and school did not seem to be well-organised and the roles of the stakeholders involved in the partnership (university tutors, head teachers and cooperating teachers) did not seem to be identified clearly. In order to help pre-service teachers to make the most of school placement and learn various teaching strategies and their underlying pedagogical values, all stakeholders need to work collaboratively with a clear agenda derived from the structure of the partnership between university and school. The poor organisation of the partnership and the lack of clarity of its strategies led to many issues including leaving the pre-service teachers without appropriate guidance where they could be influenced by negative contextual factors such as imitating undesirable practices. Moreover, the poor organisation of the partnership led to issues related to the pre-service teachers' position at school where they were seen as assistants of the school teachers with the job of supporting the school staff according to the school policy, which was far removed from the university programme. Therefore, the whole structure of the partnership between university and school in Saudi Arabia needs to be reviewed in order to activate more collaborative work among all the stakeholders. The goal of guiding pre-service teachers collaboratively to learn properly and gain pedagogical values related to the use of technology needs to be given more attention by policy makers. This requires improvement in the partnership between university and school.

In the same regard, it was found that there was a disconnection, to some extent, between the university programme and the schools’ reality and needs. Although the two institutions work under the umbrella of the same authority (the Ministry of Education), they work separately, showing conflicts in their agendas with regard to the pre-service teachers' training which, in turn, negatively influences the pre-service teachers' development in general and especially with regard to the use of technology in the classroom. Policy makers might need to consider this issue in the general strategic plans of education, giving more attention to the connection between teacher education programmes at universities and the actual situations in schools.

9.5.2 Implications for teacher educators

The study findings show that many pre-service teachers hold naïve views about the role of technology affordances, focusing on functions that serve the teaching process rather than pupils' learning. This might have lead them to adopt more traditional strategies of teaching, ignoring the important role of the pupils in their own learning. Teacher educators should pay attention to providing pre-service teachers with pedagogical knowledge that allows them to recognise technology’s affordances and to use these affordances to create an interactive learning environment where pupils take more control over their learning. Not only the pedagogical knowledge that is taught at university, but also the practical pedagogical knowledge acquired during school placement needs to be given priority by teacher educators through providing the appropriate guidance and support for pre-service teachers at schools.

The study findings demonstrate that pre-service teachers imitate their lecturers' own strategies of teaching (unintended modelling) when they develop their professional identity. This leads some pre-service teachers to adopt teaching strategies that might not be appropriate for the primary school level, such as the traditional transmission strategy of teaching using presentation technology (lecture style). Their lecturers at university constitute a powerful reference group that mediates their learning and identity development. In this case, pre-service teachers might perform what Bandura (1977) called ‘observational learning’ or learning through imitation. When pre-service teachers pay attention to their lecturers’ behaviour (the use of technology with traditional transmission strategy), they may imitate the observed teaching style regardless of whether this style is appropriate for the new context (primary school) (McLeod, 2016). Therefore, lecturers need to realise the powerful modelling function of their normal teaching at university in building pre-service teachers’ pedagogical identity. They need to realise that pre-service teachers might not recognise the pedagogical values underlying the university teaching style. When lecturers consider this issue, they would probably be able to guide pre-service teachers towards the appropriate pedagogy and help them to recognise the pedagogical values underlying different teaching styles.

The findings of the study also demonstrate that, when pre-service teachers move to the school placement, many of them are relatively isolated from the school community, which limits their learning within their zone of proximal development. Therefore, teacher education programmes need to consider preparing pre-service teachers to work collaboratively on wider social tasks, engage in the community and interact with others in order to be able to overcome the obstacles that might face them during teaching practice. Teacher educators should consider the fact that pre-service teachers might develop different sorts of identity and perceive different agency when they move to practice (Moore, 2008) which could significantly shape their pedagogical perspective. They should guide pre-service teachers to learn in their Zone of Proximal Development and guide them to gain new psychological learning tools that enable them to make the most of their ZPD.

The official guidance given to pre-service teachers during their teaching needs to take into account the social context in which teaching practice takes place. Providing pre-service teachers with feedback about their performance in the classroom, direct instructions and academic materials about teaching and learning is not sufficient to guide them to build their professional identities. Stakeholders who have an official role in pre-service teachers' practice (university tutors and cooperating teachers) do not always seem to be the reality definer for them (Nias, 1985). Instead, multiple definitions of reality might be constructed by the pre-service teachers through other reference groups to whom they hold greater loyalty. Understanding the social context where teaching practice takes place and the 'reference groups' that this context might provide can be seen as a key element for teacher educators in order to provide the appropriate guidance for the pre-service teachers.

With regard to the use of technology in the classroom in specific subject areas, it was argued that science and mathematics lessons can be looked at as different contexts each with its own nature and goals associated with different practices. Subject area seems to be an important factor in determining the nature of the use of technology and the teaching strategy being practised in the classroom. However, both science and mathematics pre-service teachers seem to lack subject specific recognition of technology’s affordances and its mediational power in teaching their subjects. Given the nature of the educational technology modules taught at university, which provide general content to all subject areas, special attention might need to be given by teacher educators to the nature of the different teaching subjects and their pedagogical demands. This could be achieved through reviewing module contents and through guiding pre-service teachers effectively during their practice at school with a strong focus on this area of knowledge.

Another important issue reported in the study findings is that of sending pre-service teachers to ‘rented schools’ where buildings and equipment are not suitable for technology integration. Therefore, teacher educators should give more consideration to the standard of the placement school. Choosing a good school that provides all necessary facilities is a key factor in helping pre-service teachers develop their skills through access to a suitable educational environment.

Many of the issues reported above seem to be caused by the weak connection between the university programme and the school reality. Thus, engaging practitioners from school in teacher education programmes might be seen as an important step in improving the quality of these programmes. The teacher educators' academic point of view does not seem to be sufficient to run a good teacher education programme. Rather, practitioners (e.g. experienced teachers, head teachers and even school administrators) need to be given an active role in the teacher education programme from an early stage of the course in order to connect the knowledge given at the university with the nature of the real practice at schools. The role of the school practitioners could take place through activities such as workshops, organising school visits prior to the school placement, or lectures.

9.5.3 Implications for school practitioners

The other issue related to the poor organisation of the partnership reported in the study findings was the poor introduction of the pre-service teachers into the school setting. The training policy showed that the pre-service teachers should attend lessons with the cooperating teachers for at least one month before they start teaching. However, this step was usually ignored according to the findings of the study. Therefore, head teachers and cooperating teachers need to activate this step as crucial in the pre-service teachers' transition from theoretical study to practice. Giving this step enough consideration might help pre-service teachers to avoid developing inappropriate pedagogical perceptions and practices related to the use of technology that might develop as a result of the lack of guidance in their early practice.

Furthermore, school practitioners need to realise that pre-service teachers come to school to develop a good teacher identity and practical knowledge. Forcing the pre-service teachers to follow the school culture (as reported in the findings) limits their identity and practical knowledge development. Therefore, school practitioners need to understand that pre-service teachers’ scope of practice needs to be widened beyond the school culture in order to prepare them to make the most of their school placement and to be ready to teach in different school environments.

9.6 Recommendations for further research

In the light of its findings and limitations, the current study could provide researchers with directions for further research in the field. First of all, as a case study, this study relied mainly on the perspectives of the participants. An ethnographic study about the use of technology by pre-service teachers and their identity and practical knowledge development could be conducted to trace their development and their transition from university courses to practice in more depth. Also, tracing their development from an early stage of their study at university might provide valuable information about their whole experience and development throughout the programme of study. Conducting this type of study would provide researchers with the opportunity to be part of the context under investigation, which would highlight many underlying aspects that would not be apparent from the participants' perspectives only.

Another recommendation for further research relates to the subject area of pre-service teachers. As the current study focused on science and mathematics pre-service teachers, it was found (as presented in Chapter Seven) that subject area is a characteristic variable that shapes, and is shaped by, the pre-service teachers' perceptions and practices related to the use of technology in the classroom. Therefore, broadening the scope of the study to include other teaching subjects could provide a wider view of pre-service teachers' perceptions and practices related to the use of technology and could lead to identifying more sociocultural factors related to this variable.

In addition, the gender of the participants in the current study could be another important extension of the current research. The study sample consisted only of male pre-service teachers, so expanding research to include female pre-service teachers could enrich the issue under investigation and reveal important sociocultural factors related to gender.

Furthermore, the current study focused on pre-service teachers of primary school level. Broadening the range of school levels to include middle and secondary schools could form another important extension of this study. The study findings show that the school level and the age of pupils are important factors influencing pre-service teachers’ perceptions and practices related to the use of technology in the classroom. Therefore, expanding the scope of research to include other school levels is likely to enrich the study and increase the value of its findings by revealing further sociocultural factors and variables related to the students’ age and the nature of the curriculum.

Another extension to this research could be its geographical expansion to other contexts. As a case study, this study focused on pre-service teachers at the University of Hail in Saudi Arabia. The study context and its settings were of extreme importance in shaping the pre-service teachers' perceptions and practices related to the use of technology in the classroom. Therefore, expanding the research to include other universities in Saudi Arabia or even outside the country could enrich the study and bring to light further factors related to context. In this regard, a comparative study could be conducted to compare the sociocultural factors that influence the pre-service teachers' perceptions and practices in different contexts.

9.7 Concluding remarks

The current study investigated the Saudi Arabian science and mathematics pre-service teachers' perceptions and practices of the integration of technology in the classroom. The relationships between their identity development, their understand of agency, and their recognition of technology affordances in the light of the practice sociocultural context were examined in depth to provide insights into the pre-service teachers' practice related to technology and their perceptions about it.

From my experience in this multiple theoretical framework study, I argue that, although sociocultural theory is a valuable framework for studying learning situations and the influence of context on the individuals' activities, researchers might find it too broad framework. The focus of sociocultural theory is very general, which raises the need for sub-frameworks to organise the focus and analyse multiple levels of the interaction within the sociocultural context. Adopting multiple sub-theoretical frameworks (TPACK, Theory of Planned Behaviour, affordance, identity and agency) within the sociocultural theory allowed me to go beyond the use of technology in the classroom itself and to investigate the underlying aspects that shape this type of practice. Accordingly, the study revealed that pre-service teachers' identity and their perceptions about their role and power in the classroom seem to lead to a specific recognition of the role of technology and its affordances in the lesson. According to how they see the role of the teacher and the learner and the relationship between them, pre-service teachers then appropriate the role of technology and focus on the specific affordances that it offers. Pre-service teachers' decisions to use (or not to use) technology do not seem to be related to technological skills or their familiarity with technology itself; rather, their pedagogical choices seem to be mediated by their identity and their perceived agency during the teaching and learning process.

One of the key strengths of this study might be its attempt (through its multiple theoretical frameworks) to trace the complexity of the relationship between the pre-service teachers' perceptions and practices related to the use of technology in the classroom in the light of the complex dynamic context that contains many important aspects that significantly shape, and are shaped by, the pre-service teachers' perceptions and practices.

At the end of this research experience, I realise that conducting this study has significantly widened my knowledge of the pre-service teachers' use of technology and taken my attention from a narrow focus on technological and personal aspects to more important contextual factors that significantly influence teachers' perceptions and practices and their professional identity and agency. I have also broadened my research skills through my engagement with the long term processes, starting from reviewing the literature in the early stages to developing the theoretical ideas that underpinned the study and ending with interpreting its findings according to its complex theoretical framework.

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11 Appendices

Appendix 1: TPACK questionnaire first version

Dear participants,

Thank you for participating to complete this questionnaire. The purpose of this questionnaire is to collect data about your perceptions of combining technology, pedagogy, and content knowledge as a part of my PhD study that explores the factors that affect the student teachers' use of ICT in education. Your valuable responses are greatly appreciated and your personal information (name, email, number, etc.) will be kept completely CONFIDENTIAL and will not affect your course grade. Please answer each question to the best of your knowledge.

Munthir Alblaihed

PhD student

University of Exeter

Part 1: Demographic Information

Name	
Email	
Mobile number	
Major	
Teaching subject	
School	
Tutor	

Part 2: Technological Pedagogical Content Knowledge

Please read the following statements and indicate the extent to which you agree or disagree with them by ticking the relevant box.

SD = strongly disagree

D = disagree

N = neither agree or disagree

A = agree

SA = strongly agree

	TK	SD	D	N	A	SA
1	I know how to solve my own technical problems.					
2	I can learn technology easily.					
3	I keep up with important new technologies.					
4	I frequently play around the technology.					
5	I know about a lot of different technologies.					
6	I have the technical skills I need to use technology.					
7	I know how to use social networks (e.g. Twitter, Facebook)					

CK

8	I have sufficient knowledge about my teaching subject.					
9	I can think about the content of my teaching subject like a subject matter expert.					
10	I have various ways and strategies of developing my understanding of my teaching subject.					

PK

11	I know how to assess student performance in a classroom.					
12	I can adapt my teaching based-upon what students currently understand or do not understand.					
13	I can adapt my teaching style to different learners.					
14	I can assess student learning in multiple ways.					
15	I can use a wide range of teaching approaches in a classroom setting.					
16	I am familiar with common student understandings and misconceptions.					
17	I know how to organize and maintain classroom management.					

PCK

18	I can select effective teaching approaches to guide student thinking and learning in my teaching subject.					
19	I can think about the content of my first teaching subject like a subject matter expert.					

20	I can address the common misconceptions my students have for my first teaching subject.					

TCK

21	I know about technologies that I can use for understanding and doing my teaching subject.					
22	I can use any software that is created specifically for my teaching subject.					
23	I can use appropriate technologies (e.g. multimedia resources, simulation) to represent the content of my first teaching subject.					

TPK

24	I can choose technologies that enhance the teaching approaches for a lesson.					
25	I can choose technologies that enhance students' learning for a lesson.					
26	My teacher education program has caused me to think more deeply about how technology could influence the teaching approaches I use in my classroom.					
27	I am thinking critically about how to use technology in my classroom.					
28	I can adapt the use of the technologies that I am learning about to different teaching activities.					
29	I can select technologies to use in my classroom that enhance what I teach, how I teach and what students learn.					
30	I can use strategies that combine content, technologies and teaching approaches that I learned about in my coursework in my classroom.					
31	I can provide leadership in helping others to coordinate the use of content, technologies and teaching approaches at my school and/or district.					
32	I can choose technologies that enhance the content for a lesson.					

TPACK

33	I can teach lessons that appropriately combine content of my teaching subject, technologies and teaching approaches.					
34	I can select technologies to use in my classroom that enhance what I teach, how I teach and what students learn.					
35	I can use strategies that combine content, technologies and teaching approaches that I learned about in my coursework in my classroom.					
36	I can provide leadership in helping others to coordinate the use of content, technologies and teaching approaches at my school and/or district.					

Models of TPACK

37	My university education professors appropriately model combining content, technologies and teaching approaches in their teaching.					
38	My educational technology professors appropriately model combining content, technologies and teaching approaches in their teaching.					
39	My educational foundation professors appropriately model combining content, technologies and teaching approaches in their teaching.					
40	My cooperating teachers appropriately model combining content, technologies and teaching approaches in their teaching.					
41	My university tutor appropriately models combining content, technologies and teaching approaches in his supervision.					

Appendix 2: TPACK questionnaire final version

Dear participants,

Thank you for participating to complete this questionnaire. The purpose of this questionnaire is to collect data about your perceptions of combining technology, pedagogy, and content knowledge as a part of my PhD study that explores the factors that affect the student teachers' use of ICT in education. Your valuable responses are greatly appreciated and your personal information (name, email, number, etc.) will be kept completely CONFIDENTIAL and will not affect your course grade. Please answer each question to the best of your knowledge.

Munthir Alblaihed

PhD student

University of Exeter

Part 1: Demographic Information

Name	
Email	
Mobile number	
Major	
Teaching subject	
School	
Tutor	

Part 2: Technological Pedagogical Content Knowledge

Please read the following statements and indicate the extent to which you agree or disagree with them by ticking the relevant box.

SD = strongly disagree

D = disagree

N = neither agree or disagree

A = agree

SA = strongly agree

	TK	SD	D	N	A	SA
1	I know how to solve my own technical problems.					
2	I can learn technology easily.					
3	I keep up with important new technologies.					
4	I frequently play around the technology.					
5	I know about a lot of different technologies.					
6	I have the technical skills I need to use technology.					
7	I know how to use social networks (e.g. Twitter, Facebook)					

CK

8	I have sufficient knowledge about my teaching subject.					
9	I can think about the content of my teaching subject like a subject matter expert.					
10	I have various ways and strategies of developing my understanding of my teaching subject.					

PK

11	I know how to assess student performance in a classroom.					
12	I can adapt my teaching based-upon what students currently understand or do not understand.					
13	I can adapt my teaching style to different learners.					
14	I can assess student learning in multiple ways.					
15	I can use a wide range of teaching approaches in a classroom setting.					
16	I am familiar with common student understandings and misconceptions.					
17	I know how to organize and maintain classroom management.					

PCK

18	I can select effective teaching approaches to guide student thinking and learning in my teaching subject.					
19	I can address the common misconceptions my students have for my first teaching subject.					

TCK

20	I know about technologies that I can use for understanding and doing my teaching subject.					
21	I can use any software that is created specifically for my teaching subject.					
22	I can use appropriate technologies (e.g. multimedia resources, simulation) to represent the content of my first teaching subject.					

TPK

23	I can choose technologies that enhance the teaching approaches for a lesson.					
24	I can choose technologies that enhance students' learning for a lesson.					
25	My teacher education program has caused me to think more deeply about how technology could influence the teaching approaches I use in my classroom.					
26	I am thinking critically about how to use technology in my classroom.					
27	I can adapt the use of the technologies that I am learning about to different teaching activities.					
28	I can select technologies to use in my classroom that enhance what I teach, how I teach and what students learn.					
29	I can choose technologies that enhance the teaching approaches for a lesson.					

TPACK

30	I can teach lessons that appropriately combine content of my teaching subject, technologies and teaching approaches.					
31	I can select technologies to use in my classroom that enhance what I teach, how I teach and what students learn.					
32	I can use strategies that combine content, technologies and teaching approaches that I learned about in my coursework in my classroom.					
33	I can provide leadership in helping others to coordinate the use of content, technologies and teaching approaches at my school and/or district.					

Appendix 3: TPACK questionnaire Arabic version for science

استبيان

عزيزي المتدرب, شكراً لاشتراكك في تعبئة هذه الاستبانة التي تهدف إلى جمع بيانات عن مفهومك عن الجمع بين المعرفة التقنية والتدريسية والتخصصية كجزء من بيانات بحث الدكتوراه الذي يستكشف العوامل التي تؤثر على استخدام التقنية في التعليم من قبل طلاب التربية الميدانية (من الأمثلة على استخدام التقنية أجهزة وبرمجيات العرض, الإنترنت, شبكات التواصل الإجتماعي, قواعد البيانات, أو أي شكل من أشكال التقنية وأدواتها). اشتراكك في تعبئة الاستبانة محل الشكر والتقدير. جميع معلوماتك الشخصية (مثل الاسم والايميل ورقم الاتصال) سوف تبقى سرية بشكل كامل ولن تؤثر استجاباتك على تقييم تدريبك الميداني حيث سوف تستخدم لغرض البحث فقط ولن يطلع عليها أحد سوى الباحث. أرجو التكرم بتعبئة الاستبانة بشكل دقيق.

منذر البليهد

طالب دكتوراه في جامعة إكستر في بريطانيا

جوال: 0505667333

الجزء الأول: البيانات الشخصية

الاسم	
الايميل	
رقم الجوال	
التخصص	
مواد التدريس	
المدرسة	
مشرف الجامعة	

الجزء الثاني: المعرفة التقنية التدريسية التخصصية

أرجو التكرم بقراءة العبارات التالية وتحديد مدى موافقتك وعدم موافقتك من خلال السلم الخماسي (لا أوافق بشدة–لا أوافق–لست متأكد–أوافق–أوافق بشدة) وذلك بوضع علامة (X) في المربع المناسب.

م	العبارة	لا أوافق بشدة	لا أوافق	لست متأكد	أوافق	أوافق بشدة
1	**أعرف كيف أحل المشاكل التقنية الخاصة بي.**					
2	**أستطيع تعلم التقنية بسهولة.**					

					دائماً أطلع على التقنيات الجديدة المهمة وأحاول تعلمها.	3
					كثيراً ما أتعامل مع التقنية.	4
					أعرف عن كثير من التقنيات المختلفة.	5
					أملك المهارات التقنية التي أحتاجها لاستخدام التقنية.	6
					أعرف كيف أستخدم شبكات التواصل الاجتماعي (مثل تويتر وفيسبوك).	7
					أملك معرفة كافية عن العلوم.	8
					أستطيع استخدام طرق التفكير العلمية.	9
					لدي طرق مختلفة واستراتيجيات لتطوير مفهومي عن العلوم.	10
					أعرف كيف أقيم أداء الطلاب في الفصل.	11
					أستطيع أن أكيف طريقة تدريسي بناءً على ما يفهمه أو لا يفهمه الطلاب حالياً.	12
					أستطيع أن أكيف طريقة تدريسي حسب اختلاف المتعلمين.	13
					أستطيع أن أقيم تعلم الطلاب بطرق متعددة.	14
					أستطيع استخدام أساليب متعددة للتدريس في الفصل.	15
					أنا على دراية بالمفاهيم الصحيحة والخاطئة الشائعة لدى الطلاب.	16
					أعرف كيف أنظم الصف وأحافظ على إدارته.	17
					أستطيع اختيار طرق تدريس فعالة لتوجيه تفكير وتعلم الطلاب في الرياضيات.	18
					أستطيع تحديد المفاهيم الخاطئة الشائعة لدى طلابي في العلوم.	19
					أعرف عن التقنيات التي أستطيع استخدامها لدراسة وفهم العلوم.	20
					أستطيع استخدام أي برمجيات صممت خصيصاً للعلوم.	21
					أستطيع استخدام تقنيات ملائمة (مثل الوسائط متعددة, المصادر, المحاكاة) لعرض محتوى العلوم.	22
					أستطيع استخدام تقنيات تعزز المحتوى لدرس معين.	23
					أستطيع اختيار تقنيات تعزز تعلم الطلاب لدرس معين.	24
					دراستي الجامعية جعلتني أفكر بعمق عن كيفية تأثير التقنية على طرق التدريس التي أستخدمها في الفصل.	25
					أفكر بطريقة نقدية بكيفية استخدام التقنية في فصلي.	26
					أستطيع أن أكيف التقنيات التي أتعلم استخدامها مع أنشطة تدريسية مختلفة.	27
					أستطيع اختيار تقنيات تعزز ما أدرس وكيف أدرس ومايتعلمه الطلاب لاستخدامها في فصلي.	28
					أستطيع استخدام تقنيات تعزز المحتوى لموضوع معين.	29
					أستطيع تدريس الدروس عن طريق الجمع بين العلوم والتقنيات وطرق التدريس بشكل ملائم.	30
					أستطيع اختيار تقنيات تعزز ما أدرس, وكيف أدرس, ومايتعلم الطلاب لاستخدامها في الفصل.	31
					أستطيع استخدام استراتيجيات تجمع المحتوى والتقنيات وطرق التدريس التي تعلمتها أثناء تدريبي في الفصل.	32
					أستطيع تقديم القيادة في مساعدة الآخرين لتنسيق استخدام المحتوى والتقنيات وطرق التدريس في مدرستي والمدارس الأخرى في المنطقة.	33

شكراً على إشتراككم في تعبئة الاستبيان

Appendix 4: TPACK questionnaire Arabic version for mathematics

استبيان

عزيزي المتدرب, شكراً لاشتراكك في تعبئة هذه الاستبانة التي تهدف إلى جمع بيانات عن مفهومك عن الجمع بين المعرفة التقنية والتدريسية والتخصصية كجزء من بيانات بحث الدكتوراه الذي يستكشف العوامل التي تؤثر على استخدام التقنية في التعليم من قبل طلاب التربية الميدانية (من الأمثلة على استخدام التقنية أجهزة وبرمجيات العرض, الإنترنت, شبكات التواصل الإجتماعي, قواعد البيانات, أو أي شكل من أشكال التقنية وأدواتها). اشتراكك في تعبئة الاستبانة محل الشكر والتقدير. جميع معلوماتك الشخصية (مثل الاسم والايميل ورقم الاتصال) سوف تبقى سرية بشكل كامل ولن تؤثر استجاباتك على تقييم تدريبك الميداني حيث سوف تستخدم لغرض البحث فقط ولن يطلع عليها أحد سوى الباحث. أرجو التكرم بتعبئة الاستبانة بشكل دقيق.

منذر البليهد

طالب دكتوراه في جامعة إكستر في بريطانيا

جوال: 0505667333

الجزء الأول: البيانات الشخصية

الاسم	
الايميل	
رقم الجوال	
التخصص	
مواد التدريس	
المدرسة	
مشرف الجامعة	

الجزء الثاني: المعرفة التقنية التدريسية التخصصية

أرجو التكرم بقراءة العبارات التالية وتحديد مدى موافقتك وعدم موافقتك من خلال السلم الخماسي (لا أوافق بشدة–لا أوافق–لست متأكد– أوافق–أوافق بشدة) وذلك بوضع علامة (X) في المربع المناسب.

م	العبارة	لا أوافق بشدة	لا أوافق	لست متأكد	أوافق	أوافق بشدة
1	**أعرف كيف أحل المشاكل التقنية الخاصة بي.**					
2	**أستطيع تعلم التقنية بسهولة.**					

3	**دائماً أطلع على التقنيات الجديدة المهمة وأحاول تعلمها.**					
4	**كثيراً ما أتعامل مع التقنية.**					
5	**أعرف عن كثير من التقنيات المختلفة.**					
6	**أملك المهارات التقنية التي أحتاجها لاستخدام التقنية.**					
7	**أعرف كيف أستخدم شبكات التواصل الاجتماعي (مثل تويتر وفيسبوك).**					
8	**أملك معرفة كافية عن الرياضيات.**					
9	**أستطيع استخدام طرق التفكير الرياضية.**					
10	**لدي طرق مختلفة واستراتيجيات لتطوير مفهومي عن الرياضيات.**					
11	**أعرف كيف أقيم أداء الطلاب في الفصل.**					
12	**أستطيع أن أكيف طريقة تدريسي بناءً على ما يفهمه أو لا يفهمه الطلاب حالياً.**					
13	**أستطيع أن أكيف طريقة تدريسي حسب اختلاف المتعلمين.**					
14	**أستطيع أن أقيم تعلم الطلاب بطرق متعددة.**					
15	**أستطيع استخدام أساليب متعددة للتدريس في الفصل.**					
16	**أنا على دراية بالمفاهيم الصحيحة والخاطئة الشائعة لدى الطلاب.**					
17	**أعرف كيف أنظم الصف وأحافظ على إدارته.**					
18	**أستطيع اختيار طرق تدريس فعالة لتوجيه تفكير وتعلم الطلاب في الرياضيات.**					
19	**أستطيع تحديد المفاهيم الخاطئة الشائعة لدى طلابي في الرياضيات.**					
20	**أعرف عن التقنيات التي أستطيع استخدامها لدراسة وفهم الرياضيات.**					
21	**أستطيع استخدام أي برمجيات صممت خصيصاً للرياضيات.**					
22	**أستطيع استخدام تقنيات ملائمة (مثل الوسائط متعددة, المصادر, المحاكاة) لعرض محتوى الرياضيات.**					
23	**أستطيع استخدام تقنيات تعزز المحتوى لدرس معين.**					
24	**أستطيع اختيار تقنيات تعزز تعلم الطلاب لدرس معين.**					
25	**دراستي الجامعية جعلتني أفكر بعمق عن كيفية تأثير التقنية على طرق التدريس التي أستخدمها في الفصل.**					
26	**أفكر بطريقة نقدية بكيفية استخدام التقنية في فصلي.**					
27	**أستطيع أن أكيف التقنيات التي أتعلم استخدامها مع أنشطة تدريسية مختلفة.**					
28	**أستطيع اختيار تقنيات تعزز ما أدرس وكيف أدرس ومايتعلمه الطلاب لاستخدامها في فصلي.**					
29	**أستطيع استخدام تقنيات تعزز المحتوى لموضوع معين.**					
30	**أستطيع تدريس الدروس عن طريق الجمع بين الرياضيات والتقنيات وطرق التدريس بشكل ملائم.**					
31	**أستطيع اختيار تقنيات تعزز ما أدرس, وكيف أدرس, ومايتعلم الطلاب لاستخدامها في الفصل.**					
32	**أستطيع استخدام استراتيجيات تجمع المحتوى والتقنيات وطرق التدريس التي تعلمتها أثناء تدريبي في الفصل.**					
33	**أستطيع تقديم القيادة في مساعدة الآخرين لتنسيق استخدام المحتوى والتقنيات وطرق التدريس في مدرستي والمدارس الأخرى في المنطقة.**					

شكراً على إشتراككم في تعبئة الاستبيان

Appendix 5: Classroom observation form

Observation tool

School:	Student teacher's name:	Subject:	Date:
Time: Start: End:	Grade:	Location:	Lesson title:
Room description:			
Students' work group:			
Student teacher's role:			
Types of technology used:			
How Student teacher uses technology:			
The importance of technology for this lesson:			
Student teacher's Knowledge: (TPACK)			

Appendix 6: Classroom observation form Arabic

أداة الملاحظة

المدرسة:	اسم المتدرب:	التخصص:	التاريخ الحصة:
الوقت: من: إلى:	الصف:	المكان:	عنوان الدرس:
وصف الغرفة:			
مجموعات عمل الطلاب:			
دور المتدرب:			
أنواع التقنية المستخدمة:			
كيف يستخدم المتدرب التقنية:			
أهمية التقنية للدرس:			
TPACK			

Pre-observation form

School:	Student teacher's name:	Subject:	Date:
Time:	Grade:	Location:	Lesson title:
Lesson description:			
Types of technology to be used in this lesson:			
How are you going to use them?			
Other information the observer should know:			

Appendix 8: Pre-observation form Arabic

استمارة ما قبل الملاحظة

المدرسة:	اسم المتدرب:	التخصص:	التاريخ الحصة:
الوقت:	الصف:	المكان:	عنوان الدرس:
وصف الدرس:			
أنواع التقنيات التي سوف تستخدم في الدرس:			
كيف سيتم استخدامها:			
أي معلومات ترى أنه من المفروض أن يطلع عليها الملاحظ:			

- يمكنك الكتابة خلف الصفحة لمساحة أكبر

Appendix 9: Interview schedule (pre-service teachers who use ICT)

Interview questions – Pre-service teachers

1- What does the school expect you to do regarding the use of ICT?
2- What does the university expect you to do regarding the use of ICT?
3- Have you been prepared at university for the school's ICT policy? How?
4- Are there any differences in the ICT use policy according to teaching subject? How?
5- Are you assessed according to your ICT use? How?
6- Are there any differences between the school and university expectations? How?
7- What is the role of head teacher in your training? How does that affect your ICT use?
8- What is the role of cooperating teacher in your training? How does that affect your ICT use?
9- What is the role of university tutor in your training? How does that affect your ICT use?
10- Are there any contradictions between their roles regarding your use of ICT? How?
11- What about you, what do you think about the use of ICT in education?
12- What do you think about the value of using ICT in your subject?
13- How does your personal history with ICT use in life?
14- Do you usually use ICT when teaching? How? Why?
15- What kind of ICT do you use in your teaching? How?
16- Do you face any difficulties with the use of ICT in education? How? How you solve them?
17- How does the school influence your ICT use?
18- How does the university influence your ICT use?
19- How do you describe the successful use of ICT in the classroom?
20- Have you been supported in ICT use by the school management? How?
21- Have you been supported in ICT use by the university tutor? How?
22- How does your relationship with other student teachers at school influence your use of ICT?
23- How does your relationship with the school teachers affect your use of ICT?
24- Who helps you in your ICT use? How?
25- Are the ICT equipment and resources available in your school? To what extent?
26- Are the ICT equipment and resources up-to-date?
27- Are the ICT equipment and resources in the school suitable for your teaching subject?
28- Do you receive any technical support in the school? Who provide this support?
29- Do you receive any technical training for using ICT in the school? How?
30- Is what you have learned at university compatible with what is needed in school?
31- Are you going to use ICT in your teaching in the future as a teacher? Why?

Appendix 10: Interview schedule (pre-service teachers who do not use ICT)

Interview questions – Pre-service teachers - Traditional

1- What does the school expect you to do regarding the use of ICT?
2- What does the university expect you to do regarding the use of ICT?
3- Have you been prepared at university for the school's ICT policy? How?
4- Are there any differences in the ICT use policy according to teaching subject? How?
5- Are you assessed according to your ICT use? How?
6- Are there any differences between the school and university expectations? How?
7- What is the role of head teacher in your training? How does that affect your ICT use?
8- What is the role of cooperating teacher in your training? How does that affect your ICT use?
9- What is the role of university tutor in your training? How does that affect your ICT use?
10- Are there any contradictions between their roles regarding your use of ICT? How?
11- What about you, what do you think about the use of ICT in education?
12- What do you think about the value of using ICT in your subject?
13- From your own experience as a student at school and university, did you get benefits from technology? How??
14- Is what prevents you from using technology in your teaching a technical reason or a belief about its value?
15- When you see the world today depends on technology in many aspects, don't you see that education could also be benefited from this technology?
16- Do you think technology could save time and effort in teaching and learning? How and why?
17- Do you think using technology in the classroom could draw pupils' attention and make the lesson interesting? Tell me more?
18- Do you think teaching traditionally with the whiteboard is enough nowadays? How? Don't you think teaching with technology more appropriate in this digital age?
19- What do you think about the role of technology in the human development in general?
20- How is your personal history and experience with technology? Tell me more?
21- Do you use technology in your teaching? How and why?
22- Have you been encouraged by the school to use technology in the classroom?
23- Have you been encouraged by your tutor to use technology in the classroom?
24- Are the ICT equipment and resources available in your school? To what extent?
25- Are the ICT equipment and resources up-to-date?
26- Are the ICT equipment and resources in the school suitable for your teaching subject?
27- Do you receive any technical support in the school? Who provide this support?
28- Do you receive any technical training for using ICT in the school? How?
29- Is what you have learned at university compatible with what is needed in school?
30- Would you use technology in your teaching if you could access appropriate training and resources related to technology? Tell me more?
31- Are you going to use technology in your teaching in the future? Why? How? Tell me more?

Appendix 11: Interview schedule for university tutors

Interview questions – University tutors

1- What does the university expect the student teachers to do regarding the use of ICT?
2- Do you assess the student teachers' performance according to his ICT use? How?
3- Are there any differences between the school and university expectations? How?
4- From your experience, how does the university raises awareness among student teachers of its ICT policy?
5- From your experience, how does the university raises awareness among student teachers of the school's ICT policy?
6- What is your role in the student teachers' training? How does that influence their ICT use?
7- Are there any contradictions between your role and the school regulations regarding the student teachers' use of ICT? How?
8- What about you, what do you think about the use of ICT in education?
9- How do you describe the successful use of ICT in the classroom?
10-Do you support the student teachers in their ICT use? How?
11-Who helps the student teacher in his ICT use? How?
12-Are the ICT equipment and resources available in the school? To what extent?
13-Are the ICT equipment and resources up-to-date?
14-Are the ICT equipment and resources in the school suitable for the student teachers' teaching subject?
15-From your opinion, Is what student teachers have learned at university compatible with what is needed in school?
16-Are there any contradictions between university and school regarding the use of ICT in education? How?

Interview questions – Head teachers

1- What does the school expect the student teachers to do regarding the use of ICT?
2- Do you assess the student teachers' performance according to their ICT use? How?
3- Are there any differences between the school and university expectations? How?
4- From your experience, how does the school raises awareness among student teachers of its ICT policy?
5- What is your role in the student teachers' training? How does that influence their ICT use?
6- Are there any contradictions between your role and the university regulations regarding the student teachers' use of ICT? How?
7- What about you, what do you think about the use of ICT in education?
8- How do you describe the successful use of ICT in the classroom?
9- Do you support the student teachers in their ICT use? How?
10- Who helps them in their ICT use? How?
11- Are the ICT equipment and resources available in your school? To what extent?
12- Are the ICT equipment and resources up-to-date?
13- Are the ICT equipment and resources in the school suitable for all teaching subjects?
14- From your opinion, is what student teachers have learned at university compatible with what is needed in school?
15- Are there any contradictions between university and school regarding the use of ICT in education? How?

Appendix 13: Arabic interview schedule (users of technology)

أسئلة المقابلة للمتدربين

اسم المتدرب: .... التخصص: .... المدرسة: ....

تاريخ المقابلة: .... وقتها: .... مكانها: ....

1 ماذا تتوقع منك المدرسة أن تفعل بخصوص استخدام التقنية في التعليم؟

2 ماذا تتوقع منك الجامعة أن تفعل بخصوص استخدام التقنية في التعليم؟

3 من وجهة نظرك, هل تم إعدادك في الجامعة لأنظمة المدرسة بخصوص استخدام التقنية؟ كيف؟

4 هل هناك أي اختلافات في قوانين استخدام التقنية حسب التخصص؟ كيف؟

5 هل يتم تقييمك بناء على استخدامك للتقنية؟ كيف؟

6 هل هناك فرق بين توقعات المدرسة والجامعة بخصوص استخدام التقنية؟ كيف؟

7 ماهو دور مدير المدرسة في تدريبك؟ كيف يؤثر ذلك على استخدامك للتقنية؟

8 ماهو دور المعلم المتعاون في تدريبك؟ كيف يؤثر ذلك على استخدامك للتقنية؟

9 ماهو دور مشرف الجامعة في تدريبك؟ كيف يؤثر ذلك على استخدامك للتقنية؟

10 هل هناك تعارضات في أدوارهم بخصوص استخدامك للتقنية؟ كيف؟

11 ماذا عنك أنت؟ ماهو رأيك عن استخدام التقنية في التعلم؟

12 ماهو رأيك عن قيمة استخدام التقنية في تخصصك؟

13 كيف هو تاريخك الشخصي أو تجربتك الشخصية مع التقنية في حياتك الخاصة؟

14 هل تستخدم التقنية في تدريسك بشكل مستمر؟ كيف؟ لماذا؟

15 ما هي أنواع التقنية التي تستخدمها في تدريسك؟ كيف؟

16 هل تواجه أي صعوبات في استخدامك للتقنية في التعليم؟ كيف؟ كيف تحل هذه المشاكل؟

17 كيف تؤثر المدرسة على استخدامك للتقنية؟

18 كيف تؤثر الجامعة على استخدامك للتقنية؟

19 برأيك, ماهو الاستخدام الناجح للتقنية في الفصل؟

20 هل تم دعمك ومساعدتك في استخدام التقنية من قبل إدارة المدرسة؟

21 هل تم دعمك ومساعدتك في استخدام التقنية من قبل مشرف الجامعة؟

22 كيف تؤثر علاقتك مع زملائك المتدربين في المدرسة على استخدامك للقنية؟

23 كيف تؤثر علاقتك مع المعلمين في المدرسة على استخدامك للتقنية؟

24 من يساعدك في استخدامك للتقنية؟ كيف؟

25 هل تجهيزات ومصادر التقنية متوفرة في المدرسة؟ إلى أي مدى؟

26 هل تجهيزات ومصادر التقنية حديثة ويتم تجديدها؟

27 هل تجهيزات ومصادر التقنية المتوفرة في المدرسة مناسبة لتدريس تخصصك؟

28 هل تحصل على دعم فني في المدرسة؟ من يقدم لك هذا الدعم؟

29 هل تحصل على تدريب تقني لاستخدام التقنية في المدرسة؟ كيف؟

30 هل ما تعلمته في الجامعة متوافق مع الحاجة الفعلية في المدرسة؟

31 هل ستستخدم التقنية في المستقبل عندما تصبح معلماً في الميدان؟ لماذا؟

Appendix 14: Arabic interview schedule (non-users of technology)

أسئلة المقابلة للمتدربين . تقليدي بدون تقنية

اسم المتدرب: .... التخصص: .... المدرسة: ....

تاريخ المقابلة: .... وقتها: .... مكانها: ....

1 ماذا تتوقع منك المدرسة أن تفعل بخصوص استخدام التقنية في التعليم؟

2 ماذا تتوقع منك الجامعة أن تفعل بخصوص استخدام التقنية في التعليم؟

3 من وجهة نظرك, هل تم إعدادك في الجامعة لأنظمة المدرسة بخصوص استخدام التقنية؟ كيف؟

4 هل هناك أي اختلافات في قوانين استخدام التقنية حسب التخصص؟ كيف؟

5 هل يتم تقييمك بناء على استخدامك للتقنية؟ كيف؟

6 هل هناك فرق بين توقعات المدرسة والجامعة بخصوص استخدام التقنية؟ كيف؟

7 ماهو دور مدير المدرسة في تدريبك؟ كيف يؤثر ذلك على استخدامك للتقنية؟

8 ماهو دور المعلم المتعاون في تدريبك؟ كيف يؤثر ذلك على استخدامك للتقنية؟

9 ماهو دور مشرف الجامعة في تدريبك؟ كيف يؤثر ذلك على استخدامك للتقنية؟

10 هل هناك تعارضات في أدوارهم بخصوص استخدامك للتقنية؟ كيف؟

11 ماذا عنك أنت؟ ماهو رأيك عن استخدام التقنية في التعلم؟ هل هي مجدية؟ كيف؟

12 ماهو رأيك عن قيمة استخدام التقنية في تخصصك؟

13 من خلال تجربتك كطالب في المدرسة والجامعة, هل استفدت من التقنية؟ كيف؟

14 هل ما يمنعك من استخدام التقنية في التعليم هو سبب فني أو قناعة عن جدواها؟

15 وأنت ترى العالم اليوم هو تقني في غالبية أموره, ألا ترى أن التعليم أولى بالاستفادة من تلك التقنية؟

16 ألا ترى أن استخدام التقنية في التعليم يوفر الوقت والجهد في عملية التعليم والتعلم؟

17 ألا ترى أن استخدام التقنية في التعليم يمثل عنصر جذب لانتباه الطلاب ويطرد الملل؟

18 هل ترى أن الطريقة التقليدية في التعليم مثل الشرح عن طريق الالقاء واستخدام السبورة والقلم كافية في وقتنا الحاضر؟ كيف؟ ألا ترى أن استخدام التقنية في التعليم يناسب الطلاب أكثر في ظل الثورة التقنية الحالية؟

19 هل ترى أن وسائل التقنية الحديثة هي جزء مهم من تطور الإنسان بشكل عام؟

20 كيف هو تاريخك الشخصي أو تجربتك الشخصية مع التقنية في حياتك الخاصة؟

21 هل تستخدم التقنية في تدريسك؟ كيف؟ لماذا؟

22 هل تم حثك على استخدام التقنية من قبل إدارة المدرسة؟

23 هل تم حثك على استخدام التقنية من قبل مشرف الجامعة؟

24 هل تجهيزات ومصادر التقنية متوفرة في المدرسة؟ إلى أي مدى؟

25 هل تجهيزات ومصادر التقنية حديثة ويتم تجديدها؟

26 هل تجهيزات ومصادر التقنية المتوفرة في المدرسة مناسبة لتدريس تخصصك؟

27 هل تحصل على دعم فني في المدرسة؟ من يقدم لك هذا الدعم؟

28 هل تحصل على تدريب تقني لاستخدام التقنية في المدرسة؟ كيف؟

29 هل ما تعلمته في الجامعة متوافق مع الحاجة الفعلية في المدرسة؟ كيف؟

30 لو توفر لك التدريب والدعم الكافي والمصادر المناسبة لاستخدام التقنية في التعليم, هل تستخدمها في تدريسك؟ لماذا؟

30 هل ستستخدم التقنية في المستقبل عندما تصبح معلماً في الميدان؟ لماذا؟

Appendix 15: Arabic interview schedule (university tutors)

أسئلة المقابلة لمشرفي الجامعة

اسم المشرف: .... المدرسة: .... الجوال: ....

تاريخ المقابلة: .... وقتها: .... مكانها: ....

1 ماذا تتوقع الجامعة من الطالب المعلم أن يفعل بخصوص استخدام التقنية في التعليم؟

2 هل يتم تقييم أداء الطالب المعلم بناء على استخدامه للتقنية في التعليم؟ كيف؟

3 هل ترى أن هناك اختلافات بين توقعات الجامعة والمدرسة من الطالب المعلم بخصوص استخدامه للتقنية؟ كيف؟

4 من خلال تجربتك الشخصية, كيف ترفع الجامعة من مستوى الادراك لدى الطلاب المعلمين عن أنظمتها المتعلقة باستخدام التقنية في التعليم؟

5 من خلال تجربتك الشخصية, كيف ترفع الجامعة من مستوى الادراك لدى الطلاب المعلمين عن أنظمة المدرسة المتعلقة باستخدام التقنية في التعليم؟

6 ماهو دورك في عملية تدريب الطالب المعلم؟ كيف يؤثر ذلك على استخدامهم للتقنية؟

7 هل هناك أي تعارضات بين دورك في تدريبهم وأنظمة المدرسة بخصوص استخدامهم للتقنية؟ كيف؟

8 ماذا عنك أنت شخصياً, ماوجهة نظرك عن استخدام التقنية في التعليم؟

9 من وجهة نظرك, ماهو الاستخدام الناجح للتقنية داخل الفصل؟ كيف تصف الاستخدام الناجح؟

10 هل تدعم الطلاب المعلمين في استخدامهم للتقنية؟ كيف؟

11 من يقدم المساعدة للطلاب المعلمين في استخدامهم للتقنية؟ كيف؟

12 هل تجهيزات ومصادر التقنية متاحة في المدرسة؟ إلى أي مدى؟

13 هل تجهيزات ومصادر التقنية في المدرسة حديثة؟

14 هل تجهيزات ومصادر التقنية في المدرسة مناسبة لجميع التخصصات؟

15 في رأيك, هل ماتعلمه الطلاب المعلمين في الجامعة متوافق مع ماهو مطلوب فعلاً في المدرسة وحسب حاجاتها؟

16 هل هناك أي تعارضات بين الجامعة والمدرسة في ما يخص استخدام التقنية في التعليم؟ كيف؟

Appendix 16: Arabic interview schedule (head teachers)

أسئلة المقابلة لمديري المدارس

اسم المدير: .... المدرسة: ....

تاريخ المقابلة: .... وقتها: .... مكانها: ....

1 ماذا تتوقع المدرسة من الطالب المعلم أن يفعل بخصوص استخدام التقنية في التعليم؟

2 هل يتم تقييم أداء الطالب المعلم بناء على استخدامه للتقنية في التعليم؟

3 هل ترى أن هناك اختلافات بين توقعات الجامعة والمدرسة من الطالب المعلم بخصوص استخدامه للتقنية؟

4 من خلال تجربتك الشخصية, كيف ترفع المدرسة من مستوى الادراك لدى الطلاب المعلمين عن أنظمتها المتعلقة باستخدام التقنية في التعليم؟

5 ماهو دورك في عملية تدريب الطالب المعلم؟ كيف يؤثر ذلك على استخدامهم للتقنية؟

6 هل هناك أي تعارضات بين دورك في تدريبهم وأنظمة الجامعة بخصوص استخدامهم للتقنية؟ كيف؟

7 ماذا عنك أنت شخصياً, ماوجهة نظرك عن استخدام التقنية في التعليم؟

8 من وجهة نظرك, ماهو الاستخدام الناجح للتقنية داخل الفصل؟ كيف تصف الاستخدام الناجح؟

9 هل تدعم الطلاب المعلمين في استخدامهم للتقنية؟ كيف؟

10 من يقدم المساعدة للطلاب المعلمين في استخدامهم للتقنية؟ كيف؟

11 هل تجهيزات ومصادر التقنية متاحة في مدرستك؟ إلى أي مدى؟

12 هل تجهيزات ومصادر التقنية في المدرسة حديثة؟

13 هل تجهيزات ومصادر التقنية في المدرسة مناسبة لجميع التخصصات؟

14 في رأيك, هل ماتعلمه الطلاب المعلمين في الجامعة متوافق مع ماهو مطلوب فعلاً في المدرسة وحسب حاجاتها؟

15 هل هناك أي تعارضات بين الجامعة والمدرسة في ما يخص استخدام التقنية في التعليم؟ كيف؟

Appendix 17: Certificate of Ethical Approval

STUDENT HIGHER-LEVEL RESEARCH
DISSERTATION/THESIS

UNIVERSITY OF EXETER

Graduate School of Education

Certificate of ethical research approval

DISSERTATION/THESIS

To activate this certificate you need to first sign it yourself, and then have it signed by your supervisor and finally by the Chair of the School's Ethics Committee.

For further information on ethical educational research access the guidelines on the BERA web site: http://www.bera.ac.uk/publications and view the School's Policy online.

READ THIS FORM CAREFULLY AND THEN COMPLETE IT ON YOUR COMPUTER (the form will expand to contain the text you enter). **DO NOT COMPLETE BY HAND**

Your name: Munthir Abdullah Alblaihed

Your student no: 580041953

Return address for this certificate: 16 Constantine House, New North Road, Exeter, EX4 4JH

Degree/Programme of Study: PhD in Education

Project Supervisor(s): Judith Kleine-Staarman and Nasser Mansour

Your email address: maa232@exeter.ac.uk and monther66@hotmail.com

Tel: 07545533778

I hereby certify that I will abide by the details given overleaf and that I undertake in my thesis to respect the dignity and privacy of those participating in this research.

I confirm that if my research should change radically, I will complete a further form.

Signed: Munthir Alblaihed **date:** 11-02-2013

NB For Masters dissertations, which are marked blind, this first page must ***not be included*** *in your work. It can be kept for your records.*

Chair of the School's Ethics Committee
updated: April 2012

Certificate of ethical research approval
DISSERTATION/THESIS

Your student no: 580041953

Title of your project: Factors impacting the student teachers' use of ICT in education.

Brief description of your research project:
The effectiveness of using information and communication technologies (ICT) in education has a great deal of debate amongst researchers and teachers. This study will seek to investigate the factors that impact on the student teacher's use of ICT in education. The research will be conducted by mixed methods approach through the lens of activity theory in three phases; firstly, the quantitative phase which seek to measure student teacher's knowledge about the use of ICT in education through a structured questionnaires that will be given to about 60 student teachers at the University of Hail in Saudi Arabia. Secondly, a qualitative phase which seek to explore the actual use of ICT in the classroom by the student teachers through classroom observation. Finally, a qualitative phase which seek to explore the factors that influence the student teacher's use of ICT in education through face-to-face interviews with around 10 student teachers, 2 university tutor, and 2 head teachers in the City of Hail in Saudi Arabia.

Give details of the participants in this research (giving ages of any children and/or young people involved):

- Student teachers at the University of Hail in Saudi Arabia who are doing school placement during the last term of their university study.
- University tutors at the University of Hail in Saudi Arabia who are supervising the student teachers.
- Head teachers in the schools where the school placement takes place in the City of Hail in Saudi Arabia.

Give details (with special reference to any children or those with special needs) regarding the ethical issues of:

a) **<u>informed consent:</u> Where children in schools are involved this includes both headteachers and parents). Copy(ies) of your consent form(s) you will be using must accompany this document.** a blank consent form can be downloaded from the GSE student access on-line documents:
Consent will be obtained from the Graduate School of Education at the University of Exeter as a first stage in order to carry out my study. This consent allows me to obtain consent from the University of Hail and the Ministry of Education in Saudi Arabia to conduct the study. In the light of these consents, I will send letters to the participants (student teachers, university tutors, and head teachers) in addition to the head teachers' letter seeking consent to conduct classroom observation explaining the purpose of the study, data collection and the sample so they understand the processes they are involved in and the importance of their participation. Consents will be obtained from all the participants who choose to participate in the interviews and observations and from the head teachers' for conducting classroom observations. Participants will be clearly informed about their right to refuse to answer any question and their right to withdraw at any stage during the data collection.

b) **<u>anonymity and confidentiality</u>**

All the participants' names and information will be kept completely confidential and will not be disclosed as they will be given pseudonyms. All the information and data collected from the participants such as completed questionnaires, interview transcripts, audio and video recording will be kept in a secure and safe place and will be destroyed later after finishing the study. Completed questionnaires and hard copies of transcripts will be stored in a locked filling cabinet. Audio and video data will be downloaded from recording devices at the earliest possible opportunity and then deleted from the recording devices. All electronic data (including audio and video recording) will be stored on a password-protected laptop and will NOT be stored on insecure devices such as memory sticks. Audio and video recording will be also deleted immediately when they are no longer needed.

Give details of the methods to be used for data collection and analysis and how you would ensure they do not cause any harm, detriment or unreasonable stress:
Questionnaire: TPACK closed-ended questionnaire will be used to measure the student teachers' technological pedagogical content knowledge to explore its influence in their use of ICT in education. The questionnaire is divided into two main parts. The first part is the demographic information that allows me to compare between the participants sub-groups when analysing data. The second is measuring their knowledge of using ICT in education. As the participation in the questionnaire is optional for the student teachers, there will be no harm or stress caused by the participation.

Observation: 6 student teachers will be observed when teaching in the classroom and the participation is optional. Although the observation focus will be on the student teachers' performance, consent will be obtained from the head teacher and the parents of children involved in the classroom.

Interview: semi-structured interview will be carried out with 6 student teachers, 2 university tutors, and 2 head teachers to study in depth factors affecting the student teachers' use of ICT in education. The participation also is optional.

Documentary evidence: All related documents in the university and school will be collected and used after obtaining the relevant consent in order to gain comprehensive understanding of the issue under investigation

Data Analysis :
Quantitative data: data from the questionnaire will be analysed by the help of the Statistical Package for the Social Sciences (SPSS).
Qualitative data: data from observation and interview will be transcribed and coded in order to be analysed according the qualitative tradition by the help of the qualitative analysis software (NVivo).

Give details of any other ethical issues which may arise from this project (e.g. secure storage of videos/recorded interviews/photos/completed questionnaires or special arrangements made for participants with special needs etc.):

All information and data collected from the participants including completed questionnaires, audio recording, and video recording will be kept confidential and will be stored in a secure and safe place as mentioned earlier. After analysing data and finishing the study, hard copy transcripts and completed questionnaires will be destroyed and audio and video recording will be deleted computers. I will insure that during observation video recording only the student teachers will be in the camera shot as the focus will be only on the student teachers' performance.

Give details of any exceptional factors, which may raise ethical issues (e.g. potential political or ideological conflicts which may pose danger or harm to participants):

As the study focus on the student teachers' use of ICT during their school placement, I will clearly inform the participants that the study is not related to their course grade and will not affect it in any way. I will highlight that the study is completely independent of their course assessment.

***This form should now be printed out**, signed by you on the first page and sent to your supervisor to sign. Your supervisor will forward this document to the School's **Research Support Office** for the Chair of the School's Ethics Committee to countersign. A unique approval reference will be added and this certificate will be returned to you to be included at the back of your dissertation/thesis.*

N.B. You should not start the fieldwork part of the project until you have the signature of your supervisor

---

This project has been approved for the period: 1st March 2013 **until:** 1st June 2013

By (above mentioned supervisor's signature): ....N. Simpson..........date:...11...02...2013

***N.B. To Supervisor:** Please ensure that ethical issues are addressed annually in your report and if any changes in the research occur a further form is completed.*

GSE unique approval reference:..............D/12/13/9.........

Signed:..**date:**...22/2/13.......
Chair of the School's Ethics Committee

Chair of the School's Ethics Committee
updated: April 2012

Appendix 18: Approval from the local educational authority in Hail

المملكة العربية السعودية
وزارة التربية والتعليم
الرمز (٢٨٠)
الإدارة العامة للتربية والتعليم بمنطقة حائل
إدارة التخطيط والتطوير
البحوث والدراسات

بسم الله الرحمن الرحيم
وزارة التربية والتعليم
MINISTRY OF EDUCATION

إدارة التربية والتعليم بحائل (بنين
التخطيط والتطوير (بنين) / مكتبالمساعد
الرقم : ٣٤٧٨٤١٢٥
بتاريخ ١٤٣٤/٠٤/٢٧ المرفقات
٧
* 3 4 7 8 4 1 2 5 *

الموضوع : تسهيل مهمة الباحث/ منذر بن عبد الله البليهد

تعميم للمدارس الابتدائية داخل مدينة حائل (بنين)

المكرم / مدير مدرسة .... وفقه الله

السلام عليكم ورحمة الله وبركاته ، وبعد:

إشارةً إلى خطاب سعادة الملحق الثقافي السعودي في لندن والمؤرخ في ١٤٣٤/٤/٨هـ بشأن تطبيق أداة دراسة بعنوان (العوامل المؤثرة على استخدام التقنية في التعليم من قبل طلاب التربية الميدانية) ..

للطالب: منذر بن عبد الله البليهد .. وذلك استكمالاً لمتطلبات الحصول على درجة الدكتوراة في تقنيات التعليم من جامعة أكستر ببريطانيا.

آمل التكرم بالتعاون مع الباحث، وتسهيل مهمته في تطبيق أداة الدراسة من قبل الفئة المستهدفة في المدرسة .

والسلام عليكم ورحمة الله وبركاته ،،،

مدير عام التربية والتعليم بمنطقة حائل

عبدالعزيز بن عبد الله المسند

Appendix 19: Permission form the University of Hail

بسم الله الرحمن الرحيم

وزارة التعليم العالي
جامعة حائل
Ministry of Higher Education
University Of Hail
كلية التربية
College of Education

مكتب العميد
Dean's Office

الرقم:.................................
التاريخ:.................................
المرفقات:.................................

إلى من يهمه الأمر

تفيد عمادة كلية التربية بجامعة حائل بأنه لا مانع لدينا من إجراء الباحث / **منذر بن عبدالله البليهد** ، والمبتعث من كليتنا لجامعة إكستر في بريطانيا ، لإجراء دراسته في الكلية وجمع البيانات من طلاب التربية الميدانية في الفصل الدراسي الثاني من العام الدراسي ١٤٣٣-١٤٣٤ هـ في الفترة من ٢٠١٣/١/٢٦ إلى ٢٠١٣/٦/١٢ م ، وذلك بهدف إتمام بحث الدكتوراه المعنون " العوامل المؤثرة على استخدام التقنية في التعليم من قبل طلاب التربية الميدانية"

عميد كلية التربية

د. فرحان بن سالم العنزي

University of Hail
College of Education
Dean's office

ص ب: ١٨١٨ - حائل - المملكة العربية السعودية - هاتف: ٠٦٥٤٣٦٣٣١ - فاكس: ٠٦٥٣٣٣٩٣٣
P.O.Box: 1818 - Hail- Saudi Arabia- Tel. : 065436331 -Fax: 065333933

Appendix 20: Consent form

UNIVERSITY OF EXETER

GRADUATE SCHOOL OF EDUCATION

Project title: Factors impacting the student teachers use of ICT in education

CONSENT FORM FOR THE STUDENT TEACHERS

I have been fully informed about the aims and purposes of the project.

I understand that:

There is no compulsion for me to participate in this research project and, if I do choose to participate, I may at any stage withdraw my participation

I have the right to refuse permission for the publication of any information about me

Any information which I give will be used solely for the purposes of this research project, which may include publications

If applicable, the information, which I give, may be shared between any of the other researcher(s) participating in this project in an anonymised form

All information I give will be treated as confidential

The researcher(s) will make every effort to preserve my anonymity

....
(Signature of participant) (Date)

....
(Printed name of participant)

One copy of this form will be kept by the participant; a second copy will be kept by the researcher

Contact phone number of researcher(Munthir Alblaihed): UK 00447545533778……Saudi 00966505667333

If you have any concerns about the project that you would like to discuss, please contact:

Monther66@hotmail.com
OR
Maa232@exeter.ac.uk

Data Protection Act: The University of Exeter is a data collector and is registered with the Office of the Data Protection Commissioner as required to do under the Data Protection Act 1998. The information you provide will be used for research purposes and will be processed in accordance with the University's registration and current data protection legislation. Data will be confidential to the researcher(s) and will not be disclosed to any unauthorised third parties without further agreement by the participant. Reports based on the data will be in anonymised form.

Information letter for student teachers

Dear student teacher

I am conducting a study to complete my PhD degree at the University of Exeter in the United Kingdom. The study purpose is to investigate the factors that influence the student teachers' use of ICT in education. That will include measuring the student teachers knowledge of using ICT through a questionnaire, Interviews with participants and classroom observation focusing on the student teachers' use of ICT in their teaching.

To conduct the study, it requires your participation by completing a questionnaire, being observed in the classroom, and then interviewed in order to collect data needed for the study. All the participants' names and information will be kept completely confidential and will not be disclosed as they will be given pseudonyms. All the information and data collected from the participants such as completed questionnaires, interview transcripts, audio and video recording will be kept in a secure and safe place and will be destroyed later after finishing the study. Audio and video recording will be also deleted immediately when they are no longer needed.

I very much appreciate your participation in this important study. If you have any concerns about the study that you would like to discuss, please do not hesitate to contact me.

The researcher

Munthir Alblaihed

Phone number: 0505667333
Email address: maa@exeter.ac.uk or monther66@hotmail.com

Appendix 22: Consent form for pre-service teachers

UNIVERSITY OF EXETER

GRADUATE SCHOOL OF EDUCATION

Project title: Factors impacting the student teachers use of ICT in education

CONSENT FORM FOR THE STUDENT TEACHERS

I have been fully informed about the aims and purposes of the project.

I understand that:

There is no compulsion for me to participate in this research project and, if I do choose to participate, I may at any stage withdraw my participation

I have the right to refuse permission for the publication of any information about me

Any information which I give will be used solely for the purposes of this research project, which may include publications

If applicable, the information, which I give, may be shared between any of the other researcher(s) participating in this project in an anonymised form

All information I give will be treated as confidential

The researcher(s) will make every effort to preserve my anonymity

....

(Signature of participant) (Date)

....

(Printed name of participant)

One copy of this form will be kept by the participant; a second copy will be kept by the researcher

Contact phone number of researcher(Munthir Alblaihed): UK 00447545533778......Saudi 00966505667333

If you have any concerns about the project that you would like to discuss, please contact:

Monther66@hotmail.com
OR
Maa232@exeter.ac.uk

Data Protection Act: The University of Exeter is a data collector and is registered with the Office of the Data Protection Commissioner as required to do under the Data Protection Act 1998. The information you provide will be used for research purposes and will be processed in accordance with the University's registration and current data protection legislation. Data will be confidential to the researcher(s) and will not be disclosed to any unauthorised third parties without further agreement by the participant. Reports based on the data will be in anonymised form.

Appendix 23: Consent form for university tutors

UNIVERSITY OF EXETER

GRADUATE SCHOOL OF EDUCATION

Project title: Factors impacting the student teachers use of ICT in education

CONSENT FORM FOR THE UNIVERSITY TUTORS

Interview – classroom observation for student teachers

I have been fully informed about the aims and purposes of the project.

I understand that:

There is no compulsion for me to participate in this research project and, if I do choose to participate, I may at any stage withdraw my participation

I have the right to refuse permission for the publication of any information about me

Any information which I give will be used solely for the purposes of this research project, which may include publications

If applicable, the information, which I give, may be shared between any of the other researcher(s) participating in this project in an anonymised form

All information I give will be treated as confidential

The researcher(s) will make every effort to preserve my anonymity

....
(Signature of participant) (Date)

....
(Printed name of participant)

One copy of this form will be kept by the participant; a second copy will be kept by the researcher

Contact phone number of researcher(Munthir Alblaihed): UK 00447545533778……Saudi 00966505667333

If you have any concerns about the project that you would like to discuss, please contact:

Monther66@hotmail.com
OR
Maa232@exeter.ac.uk

Data Protection Act: The University of Exeter is a data collector and is registered with the Office of the Data Protection Commissioner as required to do under the Data Protection Act 1998. The information you provide will be used for research purposes and will be processed in accordance with the University's registration and current data protection legislation. Data will be confidential to the researcher(s) and will not be disclosed to any unauthorised third parties without further agreement by the participant. Reports based on the data will be in anonymised form.

Appendix 24: Consent form for head teachers

UNIVERSITY OF EXETER

GRADUATE SCHOOL OF EDUCATION

Project title: Factors impacting the student teachers use of ICT in education

CONSENT FORM FOR THE HEAD TEACHERS

I have been fully informed about the aims and purposes of the project.

I understand that:

There is no compulsion for me to participate in this research project and, if I do choose to participate, I may at any stage withdraw my participation

I have the right to refuse permission for the publication of any information about me

Any information which I give will be used solely for the purposes of this research project, which may include publications

If applicable, the information, which I give, may be shared between any of the other researcher participating in this project in an anonymised form

All information I give will be treated as confidential

The researcher will make every effort to preserve my anonymity

....
(Signature of participant) (Date)

....
(Printed name of participant)

One copy of this form will be kept by the participant; a second copy will be kept by the researcher

Contact phone number of researcher(Munthir Alblaihed): UK 00447545533778……Saudi 00966505667333

If you have any concerns about the project that you would like to discuss, please contact:

Monther66@hotmail.com
OR
Maa232@exeter.ac.uk

Data Protection Act: The University of Exeter is a data collector and is registered with the Office of the Data Protection Commissioner as required to do under the Data Protection Act 1998. The information you provide will be used for research purposes and will be processed in accordance with the University's registration and current data protection legislation. Data will be confidential to the researcher(s) and will not be disclosed to any unauthorised third parties without further agreement by the participant. Reports based on the data will be in anonymised form.

Information letter for student teachers

Dear student teacher

I am conducting a study to complete my PhD degree at the University of Exeter in the United Kingdom. The study purpose is to investigate the factors that influence the student teachers' use of ICT in education. That will include measuring the student teachers knowledge of using ICT through a questionnaire, Interviews with participants and classroom observation focusing on the student teachers' use of ICT in their teaching.

To conduct the study, it requires your participation by completing a questionnaire, being observed in the classroom, and then interviewed in order to collect data needed for the study. All the participants' names and information will be kept completely confidential and will not be disclosed as they will be given pseudonyms. All the information and data collected from the participants such as completed questionnaires, interview transcripts, audio and video recording will be kept in a secure and safe place and will be destroyed later after finishing the study. Audio and video recording will be also deleted immediately when they are no longer needed.

I very much appreciate your participation in this important study. If you have any concerns about the study that you would like to discuss, please do not hesitate to contact me.

The researcher

Munthir Alblaihed

Phone number: 0505667333
Email address: maa@exeter.ac.uk or monther66@hotmail.com

Information letter for university tutors

Dear university tutor

I am conducting a study to complete my PhD degree at the University of Exeter in the United Kingdom. The study purpose is to investigate the factors that influence the student teachers' use of ICT in education. That will include measuring the student teachers knowledge of using ICT through a questionnaire, Interviews with participants and classroom observation focusing on the student teachers' use of ICT in their teaching.

To conduct the study, it requires your participation in an interview in order to collect data needed for the study. All the participants' names and information will be kept completely confidential and will not be disclosed as they will be given pseudonyms. All the information and data collected from the participants such as interview transcripts, audio and video recording will be kept in a secure and safe place and will be destroyed later after finishing the study. Audio and video recording will be also deleted immediately when they are no longer needed.

I very much appreciate your participation in this important study. If you have any concerns about the study that you would like to discuss, please do not hesitate to contact me.

The researcher

Munthir Alblaihed

Phone number: 0505667333
Email address: maa@exeter.ac.uk or monther66@hotmail.com

Information letter for head teachers

Dear head teacher

I am conducting a study to complete my PhD degree at the University of Exeter in the United Kingdom. The study purpose is to investigate the factors that influence the student teachers' use of ICT in education. That will include measuring the student teachers knowledge of using ICT through a questionnaire, Interviews with participants and classroom observation focusing on the student teachers' use of ICT in their teaching.

To conduct the study, it requires your participation in an interview and your consent to conduct classroom observations for the student teachers in your school in order to collect data needed for the study. All the participants' names and information will be kept completely confidential and will not be disclosed as they will be given pseudonyms. All the information and data collected from the participants such as interview transcripts, audio and video recording will be kept in a secure and safe place and will be destroyed later after finishing the study. Audio and video recording will be also deleted immediately when they are no longer needed.

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The researcher

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معلومات البحث – طالب التربية الميدانية

عزيزي المتدرب ... السلام عليكم ورحمة الله وبركاته

أقوم حالياً بإجراء بحث لإكمال درجة الدكتوراه في جامعة إكستر في المملكة المتحدة. يهدف هذا البحث لدراسة العوامل المؤثرة على استخدام التقنية في التعليم من قبل متدربي التربية الميدانية. يتضمن هذا البحث قياس معرفة المتدرب في استخدام التقنية من خلال استبيان ومقابلات وملاحظة في الفصل مع التركيز على استخدام المتدرب للتقنية.

لأتمكن من إجراء هذا البحث, احتاج اشتراكك فيه من خلال تعبئة الاستبيان والملاحظة في الفصل ومن ثم المقابلة الشخصية وذلك لجمع البيانات المطلوبة لإتمام هذا البحث. جميع بيانات المشتركين وأسمائهم سوف تحفظ بسرية كاملة حيث سوف يعطى رمز لكل مشترك. جميع البيانات والمعلومات التي تجمع من المشتركين مثل الاستبيان وسجل المقابلات والتسجيلات الصوتية والمرئية سوف تحفظ في مكان آمن وسوف تتلف بعد الغنتهاء من البحث. الملفات الصوتية وملفات الفيديو سوف تمسح إذا تم الانتهاء منها.

أشكرك و أقدر لك اشتراكك في هذه الدراسة المهمة , إذا كان لديك أي استفسار أو موضوع عن البحث وترغب في مناقشته, أرجو عدم التردد في الاتصال بي.

الباحث:

منذر بن عبدالله البليهد

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معلومات البحث – مشرف الجامعة

عزيزي مشرف التربية الميدانية ... السلام عليكم ورحمة الله وبركاته

أقوم حالياً بإجراء بحث لإكمال درجة الدكتوراه في جامعة إكستر في المملكة المتحدة. يهدف هذا البحث لدراسة العوامل المؤثرة على استخدام التقنية في التعليم من قبل متدربي التربية الميدانية. يتضمن هذا البحث قياس معرفة المتدرب في استخدام التقنية من خلال استبيان ومقابلات وملاحظة في الفصل مع التركيز على استخدام المتدرب للتقنية.

لأتمكن من إجراء هذا البحث, احتاج اشتراكك فيه من خلال المقابلة الشخصية وذلك لجمع البيانات المطلوبة لإتمام هذا البحث. جميع بيانات المشتركين وأسمائهم سوف تحفظ بسرية كاملة حيث سوف يعطى رمز لكل مشترك. جميع البيانات والمعلومات التي تجمع من المشتركين مثل الاستبيان وسجل المقابلات والتسجيلات الصوتية والمرئية سوف تحفظ في مكان آمن وسوف تتلف بعد الغنتهاء من البحث. الملفات الصوتية وملفات الفيديو سوف تمسح إذا تم الانتهاء منها.

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معلومات البحث – مدير المدرسة

عزيزي مدير المدرسة ... السلام عليكم ورحمة الله وبركاته

أقوم حالياً بإجراء بحث لإكمال درجة الدكتوراه في جامعة إكستر في المملكة المتحدة. يهدف هذا البحث لدراسة العوامل المؤثرة على استخدام التقنية في التعليم من قبل متدربي التربية الميدانية. يتضمن هذا البحث قياس معرفة المتدرب في استخدام التقنية من خلال استبيان ومقابلات وملاحظة في الفصل مع التركيز على استخدام المتدرب للتقنية.

لأتمكن من إجراء هذا البحث, احتاج اشتراكك فيه من خلال المقابلة الشخصية وموافقتك إجراء الملاحظات للمتدربين داخل الفصول في مدرستك وذلك لجمع البيانات المطلوبة لإتمام هذا البحث. جميع بيانات المشتركين وأسمائهم سوف تحفظ بسرية كاملة حيث سوف يعطى رمز لكل مشترك. جميع البيانات والمعلومات التي تجمع من المشتركين مثل الاستبيان وسجل المقابلات والتسجيلات الصوتية والمرئية سوف تحفظ في مكان آمن وسوف تتلف بعد الغنتهاء من البحث. الملفات الصوتية وملفات الفيديو سوف تمسح إذا تم الانتهاء منها.

أشكرك و أقدر لك اشتراكك في هذه الدراسة المهمة وموافقتك على إجراء الملاحظات للمتدربين داخل الفصل, إذا كان لديك أي استفسار أو موضوع عن البحث وترغب في مناقشته, أرجو عدم التردد في الاتصال بي.

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استبانة

عزيزي المتدرب, شكراً لاشتراكك في تعبئة هذه الاستبانة التي تهدف إلى جمع بيانات عن مفهومك عن الجمع بين المعرفة التقنية والتدريسية والتخصصية كجزء من بيانات بحث الدكتوراه الذي يستكشف العوامل التي تؤثر على استخدام التقنية في التعليم من قبل طلاب التربية الميدانية. اشتراكك في تعبئة الاستبانة محل الشكر والتقدير. جميع معلوماتك الشخصية (مثل الاسم والايميل ورقم الاتصال) سوف تبقى سرية بشكل كامل ولن تؤثر استجاباتك على تقييم تدريبك الميداني حيث سوف تستخدم لغرض البحث فقط ولن يطلع عليها أحد سوى الباحث. أرجو التكرم بتعبئة الاستبانة بشكل دقيق.

منذر البليهد

طالب دكتوراه في جامعة إكستر في بريطانيا

الجزء الأول: البيانات الشخصية

الاسم	
الايميل	
رقم الجوال	
التخصص	
مواد التدريس	
المدرسة	
مشرف الجامعة	

الجزء الثاني: المعرفة التقنية التدريسية التخصصية

أرجو التكرم بقراءة العبارات التالية وتحديد مدى موافقتك وعدم موافقتك من خلال السلم الخماسي (لا أوافق بشدة – لا أوافق – لا أعلم – أوافق – أوافق بشدة) وذلك بوضع علامة (X) في المربع المناسب.

م	العبارة	لا أوافق بشدة	لا أوافق	لا أعلم	أوافق	أوافق بشدة
1	**أعرف كيف أحل المشاكل التقنية الخاصة بي.**					
2	**أستطيع تعلم التقنية بسهولة.**					
3	**دائماً أواكب التقنيات الجديدة المهمة.**					
4	**كثيراً ما أتعامل مع التقنية.**					

5	أعرف عن كثير من التقنيات المختلفة.					
6	أملك المهارات التقنية التي أحتاجها لاستخدام التقنية.					
7	أعرف كيف أستخدم شبكات التواصل الاجتماعي (مثل تويتر وفيسبوك).					
8	أملك معرفة كافية عن العلوم.					
9	أستطيع استخدام طرق التفكير العلمية.					
10	لدي طرق مختلفة واستراتيجيات لتطوير مفهومي عن العلوم.					
11	أعرف كيف أقيم أداء الطلاب في الفصل.					
12	أستطيع أن أكيف طريقة تدريسي بناءً على ما يفهمه أو لا يفهمه الطلاب حالياً.					
13	أستطيع أن أكيف طريقة تدريسي حسب اختلاف المتعلمين.					
14	أستطيع أن أقيم تعلم الطلاب بطرق متعددة.					
15	أستطيع استخدام أساليب متعددة للتدريس في الفصل.					
16	أنا على دراية بالمفاهيم الصحيحة والخاطئة الشائعة لدى الطلاب.					
17	أعرف كيف أنظم الصف وأحافظ على إدارته.					
18	أستطيع اختيار طرق تدريس فعالة لتوجيه تفكير وتعلم الطلاب في الرياضيات.					
19	أستطيع تحديد المفاهيم الخاطئة الشائعة لدى طلابي في العلوم.					
20	أعرف عن التقنيات التي أستطيع استخدامها لدراسة وفهم العلوم.					
21	أستطيع استخدام أي برمجيات صممت خصيصاً للعلوم.					
22	أستطيع استخدام تقنيات ملائمة (مثل الوسائط متعددة, المصادر, المحاكاة) لعرض محتوى العلوم.					
23	أستطيع استخدام تقنيات تعزز المحتوى لدرس معين.					
24	أستطيع اختيار تقنيات تعزز تعلم الطلاب لدرس معين.					
25	دراستي الجامعية جعلتني أفكر بعمق عن كيفية تأثير التقنية على طرق التدريس التي أستخدمها في الفصل.					
26	أفكر بطريقة نقدية بكيفية استخدام التقنية في فصلي.					
27	أستطيع أن أكيف التقنيات التي أتعلم استخدامها مع أنشطة تدريسية مختلفة.					
28	أستطيع اختيار تقنيات تعزز ما أدرس وكيف أدرس ومايتعلمه الطلاب لاستخدامها في فصلي.					
29	أستطيع استخدام تقنيات تعزز المحتوى لدرس معين.					
30	أستطيع تدريس الدروس عن طريق الجمع بين العلوم والتقنيات وطرق التدريس بشكل ملائم.					
31	أستطيع اختيار تقنيات تعزز ما أدرس, وكيف أدرس, ومايتعلم الطلاب لاستخدامها في الفصل.					
32	أستطيع استخدام استراتيجيات تجمع المحتوى والتقنيات وطرق التدريس التي تعلمتها أثناء تدريبي في الفصل.					
33	أستطيع تقديم القيادة في مساعدة الآخرين لتنسيق استخدام المحتوى والتقنيات وطرق التدريس في مدرستي والمدارس الأخرى في المنطقة.					

شكراً على إشتراككم في تعبئة الاستبانة

استبانة

عزيزي المتدرب, شكراً لاشتراكك في تعبئة هذه الاستبانة التي تهدف إلى جمع بيانات عن مفهومك عن الجمع بين المعرفة التقنية والتدريسية والتخصصية كجزء من بيانات بحث الدكتوراه الذي يستكشف العوامل التي تؤثر على استخدام التقنية في التعليم من قبل طلاب التربية الميدانية. اشتراكك في تعبئة الاستبانة محل الشكر والتقدير. جميع معلوماتك الشخصية (مثل الاسم والايميل ورقم الاتصال) سوف تبقى سرية بشكل كامل ولن تؤثر استجاباتك على تقييم تدريبك الميداني حيث سوف تستخدم لغرض البحث فقط ولن يطلع عليها أحد سوى الباحث. أرجو التكرم بتعبئة الاستبانة بشكل دقيق.

منذر البليهد

طالب دكتوراه في جامعة إكستر في بريطانيا

الجزء الأول: البيانات الشخصية

الاسم	
الايميل	
رقم الجوال	
التخصص	
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المدرسة	
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الجزء الثاني: المعرفة التقنية التدريسية التخصصية

أرجو التكرم بقراءة العبارات التالية وتحديد مدى موافقتك وعدم موافقتك من خلال السلم الخماسي (لا أوافق بشدة – لا أوافق – لا أعلم – أوافق – أوافق بشدة) وذلك بوضع علامة (X) في المربع المناسب.

م	العبارة	لا أوافق بشدة	لا أوافق	لا أعلم	أوافق	أوافق بشدة
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3	دائماً أواكب التقنيات الجديدة المهمة.					
4	كثيراً ما أتعامل مع التقنية.					
5	أعرف عن كثير من التقنيات المختلفة.					
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27	أستطيع أن أكيف التقنيات التي أتعلم استخدامها مع أنشطة تدريسية مختلفة.					
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32	أستطيع استخدام استراتيجيات تجمع المحتوى والتقنيات وطرق التدريس التي تعلمتها أثناء تدريبي في الفصل.					
33	أستطيع تقديم القيادة في مساعدة الآخرين لتنسيق استخدام المحتوى والتقنيات وطرق التدريس في مدرستي والمدارس الأخرى في المنطقة.					

شكراً على إشتراككم في تعبئة الاستبانة

Appendix 33: Initial codes

Initial codes

1. I believe in ICT importance
2. Good for young students
3. Organise lesson teaching
4. Improves teaching and learning
5. ICT saves time and effort
6. ICT use provides training for learners in technology
7. Creativity cannot be achieved without ICT use
8. Traditional teaching is not enough nowadays
9. Presentations are the appropriate technology for primary school
10. ICT use is important particularly in science
11. Some science lessons are difficult to teach without ICT
12. Presentations help in presenting accurate drawing and shapes
13. ICT improves math learning
14. Making math interesting
15. Interactive whiteboard is important with math
16. Technology needs to be used with traditional tools in math
17. Traditional tools are more important in math
18. ICT consumes lesson time
19. Not suitable for older learners
20. Traditional tools are more suitable
21. Math and science
22. TPACK
23. ST opinions about effective ICT use
24. Tutors opinion about effective use of ICT
25. ST use ICT when the lesson demands it
26. Good technology for primary school
27. Technology use needs to be interesting to be successful
28. ICT affects lessons negatively
29. Video is a good alternative of dangerous experiments
30. Successful presentations include video and pictures
31. To be creative use ICT with video and pictures
32. Pupils like presentations with video and pictures
33. Only use presentations include video and pictures
34. Video and pictures facilitate complicated concepts
35. Tutors ask ST to use presentations with video and pictures
36. I use ICT in all lessons
37. I use presentations to present accurate drawing and shapes
38. ICT used only when teaching new lesson
39. ICT used when teaching difficult concepts
40. ICT used when equipment is available
41. To achieve creativity in teaching, use ICT
42. ST use internet to plan and prepare for lessons
43. Only with young students
44. ICT equipment is not enough in school
45. ICT is not available in rented school
46. Classrooms are equipped with ICT
47. Missing technology
48. Traditional tools used in the classroom
49. Classroom technological equipment
50. Visual presenter used with younger children
51. Presentation include video and pictures
52. Mobile phone use in the classroom
53. Software is available at school
54. Software is not available at school
55. ST buy software themselves
56. ST prepare and design software themselves

57. Exchange resources with other STs
58. Tutor guides ST to appropriate software
59. Attending lessons with teachers who use ICT
60. Practical training for ST in using computers
61. HT meetings encourage ICT use
62. ST were well-prepared for ICT use
63. University planned to provide ST with ICT skills
64. Poor preparation for ICT use
65. Limited software and hardware training
66. Lack of practical training for ICT use at university
67. School expects ST to use ICT
68. School does not required ICT use
69. Poor ICT use in school
70. Any tool, does not need to be technology
71. School does not rely on ST
72. Schools expects university to improve ICT training
73. University demands ICT use but some ST do not do
74. University does not expect me to use ICT
75. University prepare ST to use ICT
76. Tutor expects ST to use ICT in a creative way
77. Tutor expects ST to use internet for lesson planning and development
78. Tutors ask ST to use presentations in science
79. Assessment includes ICT use
80. Assessment does not include ICT use
81. Assessment includes ICT use when ICT is available
82. I do not think
83. Full mark is given to ST regardless ICT use
84. No rules differences in ICT use according to teaching subject
85. Tutor demands ST to use ICT
86. ICT types required by tutor
87. Tutor does not expect me to use ICT
88. Tutor encourages ICT use
89. Tutor attends lessons and provide support
90. Tutor guides ST to find the right software
91. Tutor expects good teaching regardless ICT
92. Tutor should practice micro-teaching with ST
93. No effective supervision
94. Lack of support by tutor when using ICT
95. Co-teacher plays an important role
96. Co-teacher encourages me to use ICT
97. Co-teacher provides technical support
98. Co-teacher provides ST with software
99. ST expects help and support from co-teacher
100. No role for co-teacher
101. HT deals with administrative aspects only
102. HT did not ask ST to use ICT
103. HT does not ask me about ICT, because I am ST
104. HT provides supervision and support
105. Difficult task to provide supervision for ST
106. ICT at university encouraged ST to learn it
107. Lecturers use of ICT familiarised ST with it
108. Workshops to encourage ICT
109. Lack of ICT labs hindered practical training
110. Projectors and presentation training
111. Interactive whiteboard
112. Only for printing
113. School atmosphere encourages ST to use ICT
114. Learners motivate ST to use ICT
115. Technical support by other ST
116. Relationship with others
117. ST encouraged to use ICT when others use it
118. Help with ICT by other teachers in school
119. Relationships with other teachers

120. Community of STs encourage and support ICT use
121. Relationships with other STs

122. School atmosphere does not encourage ICT use
123. Lack of technical training
124. Lack of support by school when using ICT
125. IT specialist provide technical support
126. Pupils families need to be engaged
127. Family support to use ICT
128. Challenges face university staff when managing training
129. Classroom is not prepared to use ICT
130. I am not prepared to use ICT
131. Operating technology sometimes difficult
132. Computer breakdown
133. Memory stick breakdown
134. How ST solve problems
135. Preparation for ICT needs time
136. ICT use consumes lesson time
137. No time to use ICT
138. Lack of English language when preparing a lesson
139. Bad mood does not allow using ICT
140. Poor classroom management
141. Poor time management
142. ST are more familiar with traditional teaching methods
143. Not suitable for older learners
144. Learners are not interested in technology
145. Current situation at school does not support ICT use
146. We were not prepared to use it
147. Only presents what is in the book
148. What is taught at university is not consistent with school needs
149. Tutors consider theoretical part and ignore practical
150. ST theoretical ideas need to be fosters
151. ST are not convinced of theories
152. No practical training
153. Unclear gap
154. University should send us to good schools in ICT
155. Meeting at the beginning of training about school environment
156. Poor organisation of training
157. ST are not prepared to teach other subjects
158. University demands ICT use while school not

Appendix 34: Codes map

Codes map

	Themes	Codes	Sub-codes	Extracts file number
1	ST views of using ICT in the classroom	ST perceptions about the use of ICT	I believe in ICT importance	1
			Good for young students	4
			Organise lesson teaching	5
			Improves teaching and learning	2
			ICT saves time and effort	3
			ICT use provides training for learners in technology	9
			Creativity cannot be achieved without ICT use	7
			Traditional teaching is not enough nowadays	8
			Presentations are the appropriate technology for primary school	6
		ST perceptions about the use of ICT with science	ICT use is important particularly in science	11
			Some science lessons are difficult to teach without ICT	10
		ST perceptions about the use of ICT with math	Presentations help in presenting accurate drawing and shapes	16
			ICT improves math learning	14
			Making math interesting	15
			Interactive whiteboard is important with math	17
			Technology needs to be used with traditional tools in math	18
			Traditional tools are more important in math	19
		Negative perceptions about ICT use	ICT consumes lesson time	20
			Not suitable for older learners	21
			Traditional tools are more suitable	22
		Tutors perceptions about ICT use	Math and science	23
2	ST personal experience with ICT	ICT used during university study		24
		ST personal experience with ICT		25
3	ICT and pedagogy	The role of technology in teaching and learning	TPACK	26
			ST opinions about effective ICT use	27
			Tutors opinion about effective use of ICT	28
			ST use ICT when the lesson demands it	29
			Good technology for primary school	30
			Technology used needs to be interesting to be successful	31
			ICT affects lessons negatively	32
		Visual function of technology	Video is a good alternative of dangerous experiments	33
			Successful presentations include video and pictures	34
			To be creative use ICT with video and pictures	35
			Pupils like presentations with video and pictures	36
			Only use presentations include video and pictures	37
			Video and pictures facilitate complicated concepts	38
			Tutors ask ST to use presentations with video and pictures	39
		Nature and purposes of technology use	I use ICT in all lessons	42
			I use presentations to present accurate drawing and shapes	41
			ICT used only when teaching new lesson	46
			ICT used when teaching difficult concepts	47
			ICT used when equipment is available	45
			To achieve creativity in teaching, use ICT	44
			ST use internet to plan and prepare for lessons	43
			Only with young students	40
4	Availability of ICT equipment in school	Availability of ICT equipment in the classroom	ICT equipment is not enough in school	48
			ICT is not available in rented school	49
			Classrooms are equipped with ICT	50
			Missing technology	51
			Traditional tools used in the classroom	52
		Types of ICT used in the classroom	Classroom technological equipment	53
			Visual presenter used with younger children	54
			Presentation include video and pictures	55
			Mobile phone use in the classroom	56

		Resources of software	Software is available at school	57
			Software is not available at school	58
			ST buy software themselves	59
			ST prepare and design software themselves	60
			Exchange resources with other STs	61
			Tutor guides ST to appropriate software	62
5	Preparation of ST to use ICT	Preparation for ICT use at school	Attending lessons with teachers who use ICT	63
			Practical training for ST in using computers	64
			HT meetings encourage ICT use	65
		Preparation for ICT use at university	ST were well-prepared for ICT use	66
			University planned to provide ST with ICT skills	67
			Poor preparation for ICT use	68
			Limited software and hardware training	69
			Lack of practical training for ICT use at university	70
6	Expectations of ICT use by ST	School expectations	School expects ST to use ICT	71
			School does not required ICT use	72
			Poor ICT use in school	73
			Any tool, does not need to be technology	74
			School does not rely on ST	75
			Schools expects university to improve ICT training	76
		University expectations	University demands ICT use but some ST do not do	77
			University does not expect me to use ICT	78
			University prepare ST to use ICT	79
			Tutor expects ST to use ICT in a creative way	80
			Tutor expects ST to use internet for lesson planning and development	81
			Tutors ask ST to use presentations in science	82
		Lack of clarity in assessment criteria	Assessment includes ICT use	83
			Assessment does not include ICT use	84
			Assessment includes ICT use when ICT is available	85
			I do not think	86
			Full mark is given to ST regardless ICT use	87
			No rules differences in ICT use according to teaching subject	88
		Potentials to use ICT in the future		89
7	Roles of stakeholders in ST training	Role of tutor in the ST training	Tutor demands ST to use ICT	90
			ICT types required by tutor	91
			Tutor does not expect me to use ICT	92
			Tutor encourages ICT use	93
			Tutor attends lessons and provide support	94
			Tutor guides ST to find the right software	95
			Tutor expects good teaching regardless ICT	96
			Tutor should practice micro-teaching with ST	97
			No effective supervision	98
			Lack of support by tutor when using ICT	99
		Role of co-teacher in ST training	Co-teacher plays an important role	100
			Co-teacher encourages me to use ICT	101
			Co-teacher provides technical support	102
			Co-teacher provides ST with software	103
			ST expects help and support from co-teacher	104
			No role for co-teacher	105
		Role of HT in ST training	HT deals with administrative aspects only	106
			HT did not ask ST to use ICT	107
			HT does not ask me about ICT, because I am ST	108
			HT provides supervision and support	109
			Difficult task to provide supervision for ST	110
8	Influence of the training environment on the use of ICT by ST	Influence of university environment on ICT use	Collected quotes ICT at university encouraged ST to learn it	 111
			Lecturers use of ICT familiarised ST with it	112
			Workshops to encourage ICT	113
			Lack of ICT labs hindered practical training	114
		Types of ICT used at university	Projectors and presentation training	115
			Interactive whiteboard	116
			Only for printing	117
		Influence of school environment on ICT use	School atmosphere encourages ST to use ICT Learners motivate ST to use ICT	118 125
			Technical support by other ST	120
			Relationship with others ST encouraged to use ICT when others use it Help with ICT by other teachers in school Relationships with other teachers Community of STs encourage and support ICT use	 121 123 122 119

			Relationships with other STs	124
			School atmosphere does not encourage ICT use Lack of technical training Lack of support by school when using ICT IT specialist provide technical support	127 128 129 126
		Outside community	Pupils families need to be engaged	130
			Family support to use ICT	131
9	Challenges	Organisational challenges	Challenges face university staff when managing training	132
		Technical challenges face ST	Classroom is not prepared to use ICT	133
			I am not prepared to use ICT	134
			Operating technology sometimes difficult	135
			Computer breakdown	136
			Memory stick breakdown	137
			How ST solve problems	138
		Time challenges face ST when using ICT	Preparation for ICT needs time	141
			ICT use consumes lesson time	140
			No time to use ICT	139
		Personal challenges face ST when using ICT	Lack of English language when preparing a lesson	142
			Bad mood does not allow using ICT	143
		Why STs do not use ICT?	Poor classroom management	144
			Poor time management	145
			ST are more familiar with traditional teaching methods	146
			Not suitable for older learners	147
			Learners are not interested in technology	148
			Current situation at school does not support ICT use	149
			We were not prepared to use it	150
			Only presents what is in the book	151
10	Partnership between school and university	A gap between theory and practice in university	What is taught at university is not consistent with school needs	152
			Tutors consider theoretical part and ignore practical	153
			ST theoretical ideas need to be fosters	154
			ST are not convinced of theories	155
			No practical training	156
			Unclear gap	157
		Partnership organisation Collected quotes	University should send us to good schools in ICT	158
			Meeting at the beginning of training about school environment	159
			Poor organisation of training	160
		St are well-prepared for school needs		161
		Contradictions between school and university expectations	ST are not prepared to teach other subjects	162
			University demands ICT use while school not	163
		Contradictions within school		164
		Contradictions within university		165

Appendix 35: Final thematic map

Final thematic map

	Themes	Codes	Sub-codes
1	Pre-service teachers' perceptions of using ICT in the classroom	The importance of technology in education	Technology improves teaching and learning
			Visual modes of technology as the ideal for primary school
		Technology role: users vs. non-users	
		Technology role: science vs. Math	The replacement function of technology in science lessons
			The additional function of technology in math lessons
		Beliefs development settings: university study vs. teaching practice	
		Challenges face the pre-service teachers adoption of technology	Technical challenges
			Time challenges
			Personal challenges
2	The pre-service teachers' experience with technology	Technology use by the pre-service teachers during their university study	
		The pre-service teachers' personal experience with technology	
3	Influence of school setting on the pre-service teachers' use of technology	Availability of technological equipment	
		Pupils' interest in technology	
		Relationships with others at school	
		School building as an influential element	
		Lack of training and support	
		School expectations for the use of technology	
4	Influence of university setting on the pre-service teachers' use of technology	Use of technology by university staff	
		Weak strategy of preparing pre-service teachers for technology use	
		University expectations for the use of technology by the pre-service teachers	
5	Partnership between university and school	Gaps between theory and practice	
		Partnership organisation	
		Organisational challenges	
		The lack of clarity in assessment criteria	
		Contradictions between university and school expectation	