Enriching Gross National Happiness through Information and Communication Technology

Karma Chewang

B.Ed. (National Institute of Education, Bhutan)

M.Ed. (Curriculum and Instruction) (University of New Brunswick, Canada)

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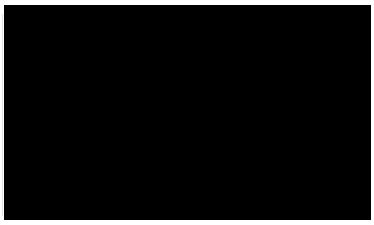
CERTIFICATE

I certify that the substance of this thesis has not already been submitted for any degree and is not currently submitted for any other degree of qualification.

I certify that any help received in preparing this thesis, and all sources used, have been acknowledged in this thesis.



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ABSTRACT

The stance taken in this study was based on two premises: GNH principles and values need to be entrenched in education, and ICT has great potential to transform learning. With these in mind, this study set out to explore the capacity of ICT to enhance GNH principles and values in pre-service teacher education in Bhutan.

Set in a pre-service teacher college in Bhutan, a mixed methods approach utilising convergent parallel design was employed in the study. Quantitative data was collected using a web-based survey instrument to determine: pre-service teacher and lecturer attitudes towards GNH and GNH in education; pre-service teacher and lecturer attitudes towards ICT in education; pre-service teacher and lecturer attitudes towards ICT enhancing GNH principles and values; and pre-service teacher and lecturer TPACK. Qualitative data was collected using focus group interviews for the pre-service teachers and semi-structured interviews for the lecturers to provide a richer view of the data. Descriptive and inferential statistics were used to analyse the web-based survey data. Thematic analysis was utilised to analyse the focus group and interview data.

The study revealed that pre-service teachers and lecturers viewed both GNH and ICT positively indicating a strong enabler to using ICT to enhance GNH principles and values at the study site. However, there are areas where attention needs to be paid if ICT is to be used to enhance GNH principles and values. For example, the lecturers in their teaching do not specifically stress GNH principles and values but rather assume that GNH principles and values are being taught unintentionally. However, results from the study suggest that in order for GNH principles and values to be enhanced by ICT, they need to be explicitly taught and modelled by lecturers. The study also discovered that both pre-service teachers and lecturers use very few ICT tools and for a limited range of activities. Furthermore, these ICT tools are mostly being used at either the *substitution* or *augmentation* level as viewed through the SAMR lens. In order for the affordances of ICT to enhance GNH principles and values to be fully realised, ICT tools need to be implemented at the *Transformation* domain of the SAMR model. This is where the level of ICT usage is either *modification* where technology allows for significant task redesign or *redefinition* where technology allows for the creation of new tasks previously not possible.

CHAPTER ONE

INTRODUCTION

This chapter provides the relevant background information for the study and is divided into twelve sections. The first section provides background information on Bhutan and introduces the concept of Gross National Happiness (GNH). The second section expands upon Gross National Happiness in order to provide the relevant contextual information to frame the study. The third, fourth, and fifth sections provide the relevant educational contextual information focusing on education in Bhutan, teacher education in Bhutan, and educating for Gross National Happiness, respectively. The sixth section examines Information Communication Technology (ICT) in pre-service teacher education in Bhutan while the seventh section examines the challenges faced when implementing ICT in education. The eight section provides background information about the researcher. The ninth section introduces the research questions for the study. The tenth section discusses the significance of the research. The eleventh section defines the key terms used in the study. The twelfth section describes the layout of the thesis.

1.1 BACKGROUND TO BHUTAN

With a population of approximately 700,000 and landmass the size of Switzerland, Bhutan is a small country landlocked between the two Asian giants, India to the south and China to the north. Bhutan is a unique country in four ways. First, although a tiny nation, Bhutan has never been colonised by any other nation and is currently a constitutional monarchy. Second, the nation's constitution requires at least 60% of the country to remain under forest cover for all time. Presently, the forest cover in Bhutan stands at 80.89% (Thinley, 2012). As a consequence, Bhutan absorbs three times more carbon than the quantity of carbon pollution it produces. Third, one of the unique features of Bhutan is a belief that consumerism and unfettered development activities will cause damage to the environment and create suffering, not only to Bhutan, but also to the rest of the world. Fourth, Bhutan bases its development on Gross National Happiness (GNH) as opposed to Gross National Product (GNP).

As it is mandated by the government that all developmental policies and plans be aligned with GNH principles, concerted efforts are made to determine that such

alignment is happening at all levels. For instance, the GNH Commission (GNHC) that allocates resources for government development activities uses a screening tool to check whether different organisations and institutions have followed the procedures mandated by GNH principles.

In order to align education with GNH principles, the Ministry of Education under the supervision of the Prime Minister and the Education Minister, initiated in 2009 an ambitious plan called *Educating for Gross National Happiness.* As part of the implementation of this plan, a series of workshops were organised for District Educational Officers (DEO), school principals, and teacher educators (Ministry of Education, 2011). The primary purpose of *Educating for Gross National Happiness* was to produce "GNH inspired teachers and a GNH infused learning environment" (Ministry of Education, 2011, p. 36). The *Educating for Gross National Happiness* initiative is elaborated upon in Chapter Two.

A study by Sherab (2014) revealed that there are two critical issues specific to teacher preparation that need to be addressed with regards to GNH in education. First, teacher capacity building is critical for the success of infusing GNH values and principles. One possible and sustainable way to achieve this is through preparation during pre-service teacher training. Second, teacher educators at the colleges of education need to model to their students how to infuse GNH in their lessons. Learning to infuse GNH should start at the colleges of education in order to produce cascading effects throughout the rest of the education system of the principles and values specified in the initiative – *Educating for Gross National Happiness.*

It has been argued that ICT used by talented teachers has the potential to transform education (Fullan, 2013; Robinson, 2010). Other studies (Herrington & Herrington, 2008; Herrington & Kervin, 2007; Jonassen, 1995; Oliver, 2003) have shown that ICT creates meaningful and authentic learning environments and experiences for students. These authors have claimed that when teachers utilise ICT as pedagogical tools, learning is transformed. The purpose of this PhD study was to explore and better understand the use of ICT across pre-service teacher education programmes to enhance GNH principles and values, as articulated in the document *Educating for Gross National Happiness.*

1.2 GROSS NATIONAL HAPPINESS

The Bhutanese government places great importance on the happiness of the people of Bhutan. This dates back to the legal code of 1729 which delineated that it is the responsibility of the government to provide happiness; otherwise the government has no right to exist (Ura, Alkire, Zangmo, & Wangdi, 2012). After the Fourth King of Bhutan ascended to the golden throne in 1972, he declared GNH to be more important than GNP. Hence, the philosophy of GNH was born and since then the country's developmental policies and plans have been guided by this philosophy. There is no specific definition of GNH but Ura et al. (2012) who carried extensive work on both the GNH Index and GNH Index survey proposed:

> Gross National Happiness (GNH) measures the quality of a country in a more holistic way than Gross National Product (GNP) and believes that the beneficial development of human society takes place when material and spiritual development occurs side by side to complement and reinforce each other (p. 7).

The primary reason why the Fourth King promulgated the GNH philosophy is that happiness of the people is a critical indicator for good development and good society (Ura, 2011). Bhutan first became a democratic constitutional monarchy in 2008 making it the youngest democracy in the world. The first democratically elected government, the Druk Phuensum Tshokpa (DPT), began fine tuning their policies and plans to more rigorously align all developmental programmes based on the GNH philosophy. It is now mandatory for developmental plans to be aligned with GNH principles. Any developmental plan that is not aligned with GNH principles is likely to be rejected when resources for developmental activities are allocated (Tshiteem, 2010). This is because Article 9 of the constitution of the Kingdom of Bhutan requires that the state provides conditions that will aid the pursuit of GNH (Royal Government of Bhutan, 2008).

GNH comprises four strategic areas known as pillars and nine domains that specify these four pillars (Ura et al., 2012). The four pillars are *Psychological well-being; Health; Education; Time-use; Cultural resilience and promotion; Good governance; Community vitality; Environment;* and *Living standards*. This GNH philosophy is enshrined in Bhutan's constitution and that is why it is special not only to the Bhutanese people but to Bhutan's relationship with the rest of the world.

1.3 EDUCATION IN BHUTAN

Prior to 1914 only a monastic Education system existed in Bhutan. Many Bhutanese went to Tibet to learn different disciplines of Buddhist studies, which helped literature, arts, philosophy and classical language of the holy book of Buddhism - the Kanjur, to flourish in Bhutan. The monastic school curriculum primarily consisted of learning ritual performance, grammar, numeracy, graphic arts, painting, chanting rhymes, philosophy, logic, and meditation (Dargye, n.d). Hence, monastic education played an important role in Bhutanese society (Tobgay, n.d) that continues today through the performance of rituals and prayers both at the local and national level. In 1914, the First King of Bhutan started a school in Haa, western Bhutan, primarily to provide experiences in handling money, solving local problems, and helping villagers take responsibilities in improving the surrounding locality (Mackey, 2002). In the same year, 46 boys were sent to India for western education to reduce the need for engagement of foreign personnel to perform administrative roles and in order to gain access to the outside world (Tobgay, n.d). In 1915, the First King founded another school at Bumthang, primarily for the Crown Prince and the children of those who served at the royal palace. There is no record of new schools being opened between 1915 and 1952.

In 1952, King Jigme Wangchuck ascended to the Golden Throne and became the Second King. In 1959, he "set up 7 to 10 Hindi medium schools" in various parts of the country, which marked the beginning of the current Bhutanese education system (Mackey, 2002, p. 1). This was also the beginning of the establishment of a more organised style of modern education (Ministry of Education, 2010). However, the education system continued with Hindi as the medium of instruction until 1961 and the schooling was mainly at the primary level.

The Third King, Jigme Dorji Wangchuck, the Father of modern Bhutan, realised that without making English the medium of instruction, Bhutan could not effectively communicate with rest of the world. Hence, since 1961 English has been the medium of instruction (Tobgay, n.d). With the commencement of the planned development initiated under the Third King in the early 1960s, Bhutan had eleven schools and approximately 400 students (Ministry of Education, 2004). However, Bhutanese students continued to attend premier Anglo-Indian schools in India after 1961 and upon their return many students played significant roles in the government (Tobgay, n.d).

In the early 1960s when Bhutan was beginning to implement a modern western education system, teachers were sought from India. In 1963, a Canadian Jesuit priest, Father William Mackey, joined by a team of teachers from India played a significant role for more than 30 years in the development of the modern Bhutanese education system (Mackey, 2002; Tobgay, n.d).

Today, the education system in Bhutan comprises three types of education: formal, non-formal, and monastic. Education is free, children begin school at age six, and school attendance is compulsory for all children until the completion of Higher Secondary level. In 2013, there were 575 schools in Bhutan employing 8,542 teachers, excluding non-formal and monastic schools (Ministry of Education, 2013).

1.4 TEACHER EDUCATION IN BHUTAN

Prior to 1970, Bhutan did not have any formally trained teachers. The visionary Third King Jigme Dorji Wangchuck realised the importance of having Bhutanese teachers to teach Bhutanese children. In order to train Bhutanese teachers, the King opened the first Teacher Training Institute (TTI) at Samtse in 1968. The first cohort of trained primary school teachers graduated from TTI in 1970 and were placed in different parts of the country (Dukpa, 2002; Zangpo, 2002). In 1975, the Teacher Training College and Demonstration School (TTC-DS) was opened at Paro to train teachers to teach lower primary level (Dorji, 2005). These two training institutes at Samtse and Paro, were later upgraded to the National Institute of Education (NIE) to train teachers, to teach higher secondary level in different disciplines including the national language Dzongkha (Dorji, 2005). NIE Samtse offered a Bachelor of Education (BEd) programme in 1983 and NIE - Paro commenced its BEd programme in 1999 (Dorji, 2005).

Since the start of the modern education system in the early 1960s, significant transformations have taken place in teacher education in Bhutan. As mentioned earlier, prior to 1970, state-based Bhutanese schools started without trained teachers and the teaching methodologies were primarily teacher-centred. Schools throughout Bhutan now only engage trained teachers. Many of the Bhutanese teachers and teacher educators have been trained overseas and are equipped with the necessary skills and experience to teach using a variety of teaching models including the learner-centred model.

1.5 EDUCATING FOR GROSS NATIONAL HAPPINESS

The vision of the former Prime Minister Jigme Y. Thinley of Bhutan, was that infusing GNH into all levels of education was more effective, comprehensive, and a far reaching means of putting GNH principles into practice (Ministry of Education, 2011). To initiate the realization of this goal, experienced and innovative educators from various countries were invited for a one-week workshop in Thimphu in December 2009. The lead role in helping develop GNH driven curricula and indicators, was taken by a group of experts from the Canadian organisation, Genuine Progress Index (GPI) Atlantic. Three successive series of workshops helping Bhutanese educators find ways to transform the entire education system to infuse GNH were organised for school principals in January and February of 2010 under the guidance of the GPI experts. This was the beginning of the GNH initiative in the education system - *Educating for Gross National Happiness*. The aims developed from these workshops (Ministry of Education, 2011) were:

> The principles and values of Gross National Happiness will deeply be embedded in the consciousness of the Bhutanese youth and citizens. They will see clearly the interconnected nature of reality and understand the full benefits and costs of their actions. They will not be trapped by the lure of materialism, and will care deeply for others and for their natural world (p. 36).

In order to achieve the aims of *Educating for Gross National Happiness*, in 2010, the Ministry of Education organised numerous workshops and training programmes. The programmes included training instructional leaders to initiate GNH related activities in schools. The Educating for Gross National Happiness initiatives in schools are achieved through five approaches, which are described in Chapter Two.

1.6 ICT IN PRE-SERVICE TEACHER EDUCATION IN BHUTAN

Until the early 1990s, even the Directors of the colleges of education did not have office computers. ICT entered the teacher training colleges in early 2000. Paro College of Education (PCE), where this study took place, received 15 computers for pre-service teacher use donated by the Korean government. However, there were no computers for lecturer-only use. Later, more computers followed with assistance of countries such as Switzerland and Singapore.

In 2003, three learning modules of Functional Information Technology (FIT) were offered to pre-service teachers at Paro College of Education. These modules mainly covered training in the use of Microsoft Office packages and Internet usage and essentially only taught basic ICT skills. In 2004, a ten module Elective IT (EIT) course was designed to cater for those pre-service teachers who would teach ICT skills in schools.

All of these programmes were implemented as a means of changing the ICT landscape in education across Bhutan. This was an important aim because ICT is intended to be used as a foundation for GNH (Ministry of Information and Communications, 2012). However, the problematic issue is that these ICT courses are mainly based on teaching ICT skills and such models tend to create what Papert (1990) called *technocentrism*. Technocentrism occurs when teaching using ICT is mainly focused on teaching ICT skills and fails to be used to enhance pedagogy. Such an approach to teaching ICT skills is unlikely to adequately prepare pre-service teachers to integrate ICT (Ertmer & Ottenbreit-Leftwich, 2010; Steketee, 2005) across the curriculum in support of GNH principles and values.

1.7 CHALLENGES FACED WHEN IMPLEMENTING ICT IN EDUCATION

In the last ten years the Bhutanese government has taken a range of initiatives to improve the quality of ICT in education. Some of these initiatives include, *Radio browsing programme; National digital library of Bhutan; Teacher training; ICTization of schools; local content development and Dzongkha localization; The One Laptop Per Child (OLPC) project; Education Development project; Healing the divide (HTD); Weaving InfoTech Resources in Education (WIRED)* with the Singapore International Foundation (SIF); and the *Chiphen Rigphel* project with Indian government assistance. During this time, computers, Internet, mobile/smart phones, and hand-held devices have penetrated the Bhutanese society dramatically. In contrast, despite the government's best efforts, ICT penetration into schools has been slow. In 2010, a World Bank (2010) survey reported that even with assistance from donor agencies and non-governmental organisations (NGOs), many initiatives that had already taken place in Bhutan were still constrained in using ICT in education, particularly in the provision of ICT infrastructure.

The World Bank survey identified three challenges for Bhutan when using ICT in education. First, Bhutan has a rugged landscape with scattered settlements, which makes providing and supporting ICT facilities very difficult. This also makes it an

extremely expensive endeavour for the Bhutanese government that depends primarily upon donor assistance. Even after the installation of ICT infrastructure, maintenance becomes a challenging undertaking for the government, especially when there is a lack of skilled ICT support personnel across the education sector. Second, a lack of skilled ICT professionals makes it difficult to leverage the benefits of ICT in education. There are limited software applications and content in the local language; a problem that is attributed to the dearth of skilled ICT professionals in Bhutan. Third, although ICT usage has proliferated in Bhutanese society, the same is not true for Bhutanese education. School children are not allowed to carry ICT devices such as mobile/smart phones, to school. According to the World Bank (2010) most Bhutanese lack ICT literacy which is one of the identified reasons for slow proliferation of ICT in education.

In addition to what the World Bank (2010) survey reported, other possible factors contributing to slow penetration of ICT in education include teachers' lack of ICT skills and teachers' lack of skills in using ICT for pedagogical enhancement (Ertmer & Ottenbreit-Leftwich, 2010).

1.8 ABOUT THE RESEARCHER

After graduating with a Bachelor of Education (BEd) degree in 1991 from the National Institute of Education in Bhutan, I taught high school Chemistry and Biology in eastern Bhutan. In 1994, I was transferred by the Ministry of Education to Paro College of Education (PCE) as a lecturer to teach Primary Science curriculum and Environmental Studies (EVS). As a lecturer, I realised that teaching how to teach primary science was very different from teaching high school science. I received a Canadian International Development Agency (CIDA) scholarship from the Bhutanese government to pursue a Master of Education (MEd) at the University of New Brunswick, Canada from 1996 to 1999. My MEd studies focused on Primary Science curriculum and instruction and the research focused on continuous assessment in Primary Science in Bhutan. In response to the almost ubiquitous nature of ICT and the way teaching and learning has fundamentally changed, requiring one to be a lifelong learner, I enrolled in the PhD programme at the University of New England, Australia to explore aspects of this interplay.

The research undertaken in the study described in this thesis was motivated by three critical factors. First, I had experienced and observed numerous initiatives taken by the

Bhutanese government to enhance pedagogical practices both in schools and colleges of education. Such initiatives to improve pedagogical practices included long-term studies in western universities, in-service programmes for both teachers and teacher educators, and workshops run by experts from overseas. Unfortunately, studies (Young, 2012) have shown that even at the colleges of education in Bhutan pedagogical practices are dominated by a lecture method-based approach. This might be considered as ironic because it does not reflect the numerous exposures and knowledge concerning modern teaching pedagogy. It is crucial that the faculty at the colleges of education practice what they teach because pre-service teachers are likely to teach the way they were taught.

Second, the *Educating for GNH* initiative mandates that the school and colleges of education curriculums be aligned with GNH principles and values. The aims and objectives of *Educating for GNH* are good but the question remains whether teachers are well enough equipped to deal with this new initiative; making GNH a part of every school activity and day-to-day teaching. A recent postgraduate study (Sherab, 2014) has shown that there are still challenges in implementing GNH in education. Sherab's findings identified the existence of a gap between government expectations and the quality of teacher preparation in the pursuit of GNH for Education. Some of the study's findings included: lack of training; lack of adequate preparation and readiness; and lack of adequate teaching strategies to infuse GNH into teaching. To me, this indicated the need for improving the quality of teacher training at the pre-service level to adequately prepare the teachers to be able to infuse GNH in their lessons. I believe this is particularly important in the pursuit of *Educating for GNH* at the pre-service teacher level as the way pre-service teachers are taught will significantly influence the way they are going to teach GNH values and principles in the future.

Third, the primary motivation for this study was the *Educating for Gross National Happiness* initiative that aspires to bring about transformational change to the Bhutanese education system by creating conditions that are enjoyable, engaging, and relevant to learners. Both physical and psycho-social ambience are expected of *Educating for Gross National Happiness* initiatives, through the day-to-day teaching and learning process and co-curricular activities (Ministry of Education, 2011). Most importantly, the *Educating for Gross National Happiness* initiative is designed to create conditions that enable the infusion of GNH principles and values in the consciousness

of students through different school education processes. This was expressed by Jigme Y. Thinley in an address to international experts at an implementation workshop.

> Infusing Gross National Happiness in the Education system is not adding a new subject but enriching learning, and improving the process of education. It has to do with creating a context and an approach that infuses a Gross National Happiness consciousness into everything that is learned and taught. This will make the curriculum and learning more enjoyable, more pleasurable, and more relevant (Thinley, 2010, p. 3).

Jigme Y. Thinley went on to add:

> Often there is no clarity as to why we teach things, and so learning is inevitably boring. Infusing Gross National Happiness understanding creates a purpose and goal for teaching and learning to both teachers and students that makes study less burdensome and more enjoyable (Thinley, 2010, p. 3).

1.9 RESEARCH QUESTIONS

The stance taken in this study is based on two premises: GNH principles and values need to be entrenched in education and ICT has great potential to transform learning.

The first premise is based on the document, *Educating for Gross National Happiness: Refining our school education practices* (Ministry of Education, 2011) that specified teaching and learning need to be aligned with GNH principles and values. The document outlines the importance of transforming educational practices by making learning "more enjoyable, more pleasurable, and more relevant" (Ministry of Education, 2011, p. 53). Values that are explicitly stressed in the document include: deep critical thinking and creative thinking; ecological literacy; valuing Bhutan's ancient wisdom and culture; contemplative learning; understanding the world holistically; caring for nature and fellow citizens; civic engagement; competency to effectively deal with the modern world; and preparation for right livelihood. Further principles and values of GNH are presented in Chapter Two.

The second premise, based on Fullan (2013), is that ICT has the potential to improve and accelerate student learning, which is similar to what *Educating for GNH* advocates. Fullan (2013) argued that the right combination of ICT, pedagogy, and change knowledge makes learning irresistibly engaging and meaningful for learners.

However, there are challenges because it is not exactly GNH or ICT per sé but the pedagogy involved that transforms learning. Infusing GNH in classroom lessons in Bhutan is seen as a challenge due to "lack of awareness, knowledge, and motivation" about GNH (Sherab, 2014, p. 252). Similarly, using ICT as pedagogical tools is not without problems. For instance, integrating ICT requires certain kinds of knowledge (Mishra & Koehler, 2006) and teachers need to understand how learning is enhanced when ICT is used (Ertmer & Ottenbreit-Leftwich, 2010).

As a lecturer, the researcher has taught ICT as well as other subjects but rarely utilised ICT as a pedagogical tool effectively mainly due to a lack of skills in integrating ICT across the curriculum. The researcher's experiences and observations at the college of education, where he was employed, led to the impression that pre-service teachers get little or no exposure to using ICT as a pedagogical tool.

To address the challenges of utilising ICT to enhance GNH principles and values in pre-service teacher education, the following research questions were identified:

- What are pre-service teacher and lecturer attitudes towards GNH?
- What are pre-service teacher and lecturer attitudes towards ICT use?
- What are the enablers of the use of ICT to enhance GNH in education in pre-service teacher education?
- What are the inhibitors of the use of ICT to enhance GNH in education in pre-service teacher education?

1.10 SIGNIFICANCE OF THE RESEARCH

The findings of this study have three critical implications for the Bhutanese education system. First, the findings may be used to inform teacher educators on how to better align GNH principles and values using ICT to enhance learning environments. Second, the findings may assist educational policy makers to make GNH education more effective. Third, this research has theoretical significance because to date, no study has been undertaken in pre-service teacher education in Bhutan informed by Technological Pedagogical and Content Knowledge (TPACK), a recognised framework of teacher knowledges for the integration of ICT.

1.11 DEFINITION OF KEY TERMS

The definition/scope of commonly used terms employed in the study follows.

Gross National Happiness (GNH): GNH is Bhutan's development philosophy. The phrase Gross National Happiness (gyal-yong ga'a-kyid pal-'dzoms) was devised by Bhutan's fourth King, Jigme Singye Wangchuck in 1972, representing a commitment to building an economy based on Buddhist spiritual values and culture, instead of the western material development gauged by Gross Domestic Product (GDP). Today's GNH evolved through the contribution of international scholars and researchers to become Bhutan's socioeconomic development framework.

Information Communication Technology (ICT): Digital technologies including computers, laptops, iPads, mobile/smart phones, software and web-based technologies.

Technology: Technology(ies) will be understood similar to ICT. In this study, the term ICT and technology will be used interchangeably.

Virtual Learning Environment (VLE): A web-based platform that provides for the creation, delivery and administration of online learning. At the study site, the VLE used was Moodle. The term VLE is often used interchangeably with Learning Management System (LMS).

1.12 LAYOUT OF THE THESIS

The thesis comprises four main parts. The first part (Chapters One and Two) concerns itself with the research settings and supporting literature. The second part (Chapters Three and Four) describes the methodology adopted and the development of the research instruments. The third part (Chapters, Five, Six, Seven, and Eight) reports the results of the survey and interview-based instruments. The fourth part (Chapter Nine) brings together the results, addresses the research questions, and reports the overall research findings. Supporting these chapters, a series of appendices at the end of the thesis are provided.

CHAPTER TWO

LITERATURE REVIEW

This chapter reviews the literature relevant to the focus of the study and is made up of ten sections. The first section explores the *Educating for GNH* initiative that forms the cornerstone of the study. The second section examines the critical elements for teaching required to achieve the aspirations of a GNH-infused curriculum. The third section describes the importance of ICT integration in general with the fourth section examining ICT integration specifically in pre-service teacher education. The fifth section discusses why it is important for lecturers to model ICT use to their students. The sixth section describes a number of ICT integration models with sections seven and eight describing two particular ICT integration models, TPACK and SAMR respectively. Section nine, provides an overview of change management practices in education as a means of exploring how ICT integration in educational settings are informed by models such as TPACK and SAMR. The tenth section provides a conclusion to the chapter.

2.1 EDUCATING FOR GNH: REFINING OUR SCHOOL EDUCATION PRACTICES

Since Bhutan's developmental vision is based on the philosophy of Gross National Happiness (GNH), all government organisations and agencies are mandated to align their developmental activities with GNH principles. Education in Bhutan is considered the cornerstone of progress in society because it cuts across all other domains of GNH. The vision of GNH in education is incorporated into the education system through the initiative, *Educating for GNH*, which "promotes holistic, contemplative, eco-sensitive, and culturally responsive education approaches that are both taught and put into practice" (Ministry of Education, 2012, p. 5).

2.1.1 An Overview of GNH

Bhutan is popularly known for the concept of Gross National Happiness, which rest upon four pillars:

- Sustainable and equitable socio-economic development.
- Environmental conservation.

- Preservation and promotion of culture.
- Good governance.

There are nine domains and thirty-three indicators that make up the *GNH Index* which is used as a public policy making framework in Bhutan. The nine domains are: *Psychological well-being*; *Health*; *Education*; *Time-use*; *Cultural resilience and promotion*; *Good governance*; *Community vitality*; *Environment*; and *Living standards*. From a GNH perspective, the nine domains clearly demonstrate that numerous factors are considered to be important in creating conditions for happiness (GNH Centre Bhutan, n.d). Article Nine of the constitution of the Kingdom of Bhutan mandates that the State shall be responsible for promoting conditions necessary to enable the pursuit of GNH (Royal Government of Bhutan, 2008). Accordingly, all policy making across different public organisations in Bhutan are mandated to align their policies and plans with GNH philosophy.

2.1.2 Education and GNH

The importance of the education domain as a cornerstone of the GNH-based developmental model is reflected in the words of the former Prime Minister of Bhutan, Jigme Y.Thinley (2010) who initiated the GNH in education initiatives in Bhutan:

> There is absolutely no better place to begin the transformation that is needed than with education – simply because every aspect and domain of Gross National Happiness requires knowledge and understanding for its realization; because only through education can we bring about deeper change in consciousness that must be at the root of all actions for a better world; and because, as our Majesties continuously reminds [sic] us, the future of our country lies firmly in the hands of our young (p. 102).

Education is considered the core of the GNH Index because every GNH pillar and domain literally depends on good education and education is the only means through which essential change of consciousness can occur (Thinley, 2010). It can also be argued that initiating GNH in education is the right approach because education has a far reaching impact on society (Ministry of Education, 2011). Considering the important role education plays in the all round development of the nation, Bhutan initiated a massive education reform in 2010 under the direct supervision of Bhutan's former Prime Minister and Education Minister. This reform provides an excellent example of how different public organisations in Bhutan can align their developmental

plans and policies through a GNH lens as mandated by the constitution. GNH in education in Bhutan is conveyed through the document, *Educating for Gross National Happiness: Refining our school education practices* (Ministry of Education, 2011).

Creating and nurturing healthy and sustainable societies that enhance the well-being of people requires knowledge and wisdom to benefit the common good (Hayward, Pannozzo, & Colman, 2009). In order for graduates to succeed in the 21st century they need to possess skills to think critically, solve problems, communicate effectively, and collaborate (Partnership for 21st century skills, 2007). Bhutan's approach to producing successful graduates for the 21st century is being pursued by transforming the entire education system through cultivating GNH principles and values. These include:

> critical and creative thinking, ecological literacy, practices of country's profound ancient wisdom, and culture, contemplate learning, holistic understanding of the world, genuine care for nature and others, competency to deal effectively with the modern world, preparation for right livelihood, and informed civic engagement (Ministry of Education, 2011, p. 36).

The *Educating for Gross National Happiness: Refining Our School Education Practices* initiative aims to produce GNH inspired graduates with five crucial attributes related to self, family, community, workplace, and citizens (Ministry of Education, 2011).

The quality of a GNH inspired graduate pertaining to the first attribute, *self,* includes being resourceful, creative, confident, reflective, upright, compassionate, and sensitive. The second attribute, *family,* includes giving pure or unconditional love; taking responsibility within the family; respecting and appreciating indigenous value systems; making intelligent decisions; and demonstrating a high sense of gratitude. The third attribute relates to one's *community*, including providing community activities and services; engaging in cultural events and activities; practising mutual respect and care for others; caring for the property and environment of the community; promoting equity and justice; and nurturing and caring. The fourth attribute relates to *workplace*, which requires graduates to be able to choose a right livelihood; practise the right attitude; practise right conduct with others; be an inspirational role model; be a change agent and leader; have joy in work; be competent and productive; and be mindful. Finally, the attribute *citizen* comprises being well informed, aware, and actively involved in democratic activities; resourceful and creative; honest; resistant to corruption with a strong sense of justice; and practise right livelihood based on

ecological consciousness. Such attributes of a GNH inspired graduate are crucial because it is these values that form the basis to lead a better life (Debbarma, 2014). *Educating for GNH: Refining Our School Education Practices* aims to nurture these qualities in Bhutanese youth when they are at school.

This reform initiative started with workshops organised for educational leaders including school principals at Paro College of Education in 2009 and 2010. The outcome of the workshops was the pledge made by all educational leaders that GNH principles and values would be infused into every aspect of educational activities across Bhutan (Ministry of Education, 2011). There are numerous ways GNH can be infused into the Bhutanese education system. The Ministry of Education in Bhutan has chosen five different approaches to inculcating GNH principles and values into the education system (Ministry of Education, 2011; n.d, p. xiv).

- *Meditation and mind training*: mindfulness and mind training exercises for positive effects on students.
- *Infusing GNH into the school system:* identifying and incorporating GNH values into lessons that teachers teach.
- *Broader learning environment*: creating an ambient learning environment.
- *Holistic assessment of children*: using different methods of assessing student learning. This includes the use of both summative and formative assessment methods.
- *Media literacy and critical thinking*: ability to judge what is being said or written in the media. Learning to evaluate different types of media.

These five approaches to the education reform programme in Bhutan were planned to be achieved through a programme "nurturing Green School for Green Bhutan" (Powdyel, 2014, p. 4). Powdyel (2014) argued that learning in Bhutanese classrooms is not as effective as it should be and to address this the green school concept looks at learning from more holistic perspectives. In an effort to restore the true essence of education, Powdyel (2014) proposed eight dimensions to *Green Schools*:

- *Natural greenery*: maintaining and taking care of the surrounding natural environment.
- *Social greenery:* learning to appreciate living together, contributing to common cause and community vitality.
- *Cultural greenery:* appreciating one's culture and learning to preserve it.

- *Intellectual greenery:* engaging in positive thinking, constructive dialogue, and meaningful action leading to creative engagement of mind.
- *Academic greenery:* taking pride in excellence by speaking well, reading well, listening sensitively, thinking intelligently, analysing critically and interpreting objectively.
- *Aesthetic greenery:* creating life-supportive stimuli that invite wholesome responses, and sensitivity towards objects of beauty.
- *Spiritual greenery:* conditions necessary for inner life that accept and honour the divine in us and that link us to the divine higher than us.
- *Moral greenery:* cultivates the values such as being a fair, just, and caring society.

The *Green School* approach to *Educating for GNH* mandates individual roles across the whole Bhutanese educational system to teach and practice GNH values. For instance, school principals are expected to create conditions that are necessary for the pursuit of GNH in a school as a whole, while teachers are expected to not only model but also embed GNH values in their day-to-day teaching. Equally important is that all school principals and teachers are expected to practise what they preach in regard to infusing GNH principles and values. Therefore, infusing GNH into the education system is all about enriching learning and improving the process of education (Thinley, 2010).

2.1.3 ICT and Educating for GNH

It is the policy of the Bhutanese government to create an ICT-enabled knowledge society as a foundation for GNH (Ministry of Information and Communications, 2012). Accordingly, the National Education Policy (NEP) of the Ministry of Education (2012) provide broad directives to the national education system:

- All schools will be provided with IT infrastructure with high speed Internet facilities.
- Students will be IT literate.
- Collaborative learning using ICT will be used to promote creativity in students.
- IT education will be integral to professional development to enhance curriculum delivery.

Using ICT as a foundation for GNH makes sense in enhancing GNH through education because ICT, with the support of talented teachers, has the potential to revolutionise education (Robinson, 2010).

However, the preparation for using ICT in education must begin with pre-service teacher education programmes. As argued by Albion and Redmond (2008, p. 1), "if, as is often the case, teachers' first impulse is to teach as they were taught, then the most effective way to prepare them to teach with ICT may be to ensure that ICT is integral to teacher preparation programs".

2.2 ELEMENTS OF TEACHING

As mentioned previously, *Educating for GNH* requires schools and institutions to create an ambience for learning without having to add curricular content, and to make learning more engaging, less burdensome and more fun (Thinley, 2010). Research has shown that the constructivist philosophy combined with digital technologies has great potential in assisting both students and teachers in creating authentic and meaningful learning (Herrington & Herrington, 2006; Howland, Jonassen, & Marra, 2012; Reeves, Herrington, & Oliver, 2002). Creating a conducive intellectual learning environment with appropriate intellectual tools, such as computers, is crucial in determining how fast, easily, and enjoyably students learn. This happens because of the learners' intrinsic motivation (Papert, 1990). A study by Passey, Rogers, Machell, and McHugh (2004) found that technology has tremendous positive impact on a learners' motivation level in areas such as learning and school attendance. Papert and Harel (1991) argued that technology provides an excellent context for knowledge construction thus advocating the idea of learning-by-making which creates and fosters student-centred learning. This is especially relevant and important as learning is more effective when learners are engaged in an active learning process that encourages them to construct personally meaningful products, which can be shared with other relevant individuals such as teachers, friends, and parents (Resnick, 1996; Willis & Tucker, 2001). Thus, technology is important in that it creates a constructive medium for learners through the change of the learning environment to empower learners intellectually (Papert, 1998) and give them the technological tool sets for 21st century learning (Stager, 2001).

Technology is also an enabling force that allows learners to "communicate, learn, share, collaborate and create, to think and solve problems, to manage their work to take ownership of their lives" (Vockley, 2007, p. 6). Technology plays a central role in supporting deep learning (Fullan & Langworthy, 2013, 2014), authentic learning (Lombardi, 2007), and meaningful learning (Howland et al., 2012) for students. Considering the crucial role technology plays in the lives of 21st century learners, it is more sustainable to equip teachers with the relevant knowledge during their years as

pre-service teachers rather than training them through teacher professional development programmes. Fullan and Langworthy (2013) reported that professional development programmes are important but insufficient to bring substantial change to new pedagogical practices that create meaningful learning environments (Fullan & Langworthy, 2013). The following sections expand upon the three elements of learning influenced by the use of technology previously mentioned: *deep learning, authentic learning,* and *meaningful learning*. Importantly, these elements of learning are consistent with the principles and values of GNH.

2.2.1 Deep learning with technology

Deep learning advocates that education and learning fulfils skills that prepare students to become "life-long creative, connected and collaborative problem solvers and to be healthy, happy individuals who contribute to the common good in today's globally interdependent world" (Fullan & Langworthy, 2013, p. 2). This has direct relevance to GNH principles and values specified in *GNH in Education*.

Deep learning, defined as *creating* and *utilizing* new knowledge, is enhanced by technology which can play a critical role when leveraged by the new pedagogies that enable students to apply new knowledge in real world situations (Fullan & Langworthy, 2014). Character education, citizenship, communication, critical thinking and problem solving, collaboration, and creativity and imagination are the ultimate goals of deep learning (Fullan & Langworthy, 2013). Deep learning takes place through a carefully crafted learning environment created by the teacher where two conditions are deemed crucial: use of technology, and use of new pedagogy (Fullan & Langworthy, 2013, 2014; Garcia, 2015). According to Garcia (2015) deep learning is achieved through five cultural transitions.

- *Engage in Inquiry-based professional development*: educators themselves engage in acquiring and developing inquiry skill possibly within the field of philosophy.
- *Formulate a classroom community of inquiry*: educators encourage students to respect others' views in a community or group.
- *Start simply and exercise the brain daily*: start with a simple thinking exercise and provide opportunities to practice inquiry skill on a daily basis.
- *Make learning relevant*: make learning relevant, meaningful, and tied to the general characteristics of students.

- *Integrate technological resources*: using technological tools to encourage higher order thinking.

The ultimate goal of deep learning is to provide learners with skills for lifelong learning, creativity, connected and collaborative problem solving. This is to enable learners to successfully participate, as well as innovate, in an ever increasingly interconnected world. The attributes of deep learning are consistent with the attributes of successful GNH graduates (Hayward et al., 2009; Ministry of Education, 2011).

2.2.2 Authentic learning with technology

Authentic learning is where the learning environment is inherently multidisciplinary and emphasis is placed on real-world, complex problems and solutions (Lombardi, 2007). Some examples of authentic learning activities include "use of role-playing exercises, problem-based activities, case studies, and participation in virtual communities of practice" (Lombardi, 2007, p. 2). Authentic learning is influenced by the constructivist philosophy of learning, which enables learners to create, innovate, and communicate, in situations that resemble real world problems (Herrington & Herrington, 2006). Authentic learning can be considered to comprise nine characteristics: authentic context; authentic activities; expert performance; multiple roles and perspectives; reflection; collaboration; articulation; coaching and scaffolding; and integrated authentic assessment (Herrington & Kervin, 2007).

Learning activities in authentic learning resemble real-world problems with students performing tasks that have relevance to their immediate life. ICT enables students to pursue collaborative work, think critically, organise information, and be innovative and creative in authentic learning (Lombardi, 2007). Studies (Herrington & Kervin, 2007; Jonassen, 1995) have shown that ICT is an excellent intellectual partner for students in solving complex problems resulting in the enhancement of their learning. Authentic learning benefits students in five different ways by:

- motivating students;
- helping students to learn better;
- preparing students for the future;
- making concepts easier to assimilate;
- blending theory with practice.

Educating for GNH is the pursuit of the enrichment of student learning by giving heartfelt and genuine context, purpose, and meaning (Thinley, 2010). Since authentic

learning uses authentic tasks, it has relevance to what *Educating for GNH* mandates for the education system in Bhutan.

2.2.3 Meaningful learning with technology

Technology is an excellent facilitation and knowledge construction tool that can enhance a learner's cognitive capacity, including the ability to think critically (Jonassen, 1995). Meaningful learning occurs when learners are intentionally engaged in tasks that are active, constructive, intentional, authentic, and cooperative (Howland et al., 2012). Meaningful learning takes place when the learning task requires students to construct, test, compare, and evaluate their creations and is facilitated by use of technology tools (Jonassen & Strobel, 2006). Meaningful learning using technology is learning *with* technology where technology becomes an intellectual partner in the student's learning process (Howland et al., 2012; Jonassen, 1995). Howland et al. (2012) outlined five types of supporting roles technology plays in promoting meaningful learning:

- as tools to support knowledge construction;
- as an information vehicle for exploring knowledge to support learning by construction;
- as authentic context to support learning by doing;
- as social medium to support learning by conversing;
- as intellectual partner to support learning by reflecting.

The use of technological tools in meaningful learning involves knowledge construction, collaboration, and critical thinking; necessary 21st century skills (Howland et al., 2012). *Educating for GNH* encompasses similar sets of skills deemed vital to improving the quality of education in Bhutan, especially through the use of ICT (Ministry of Education, 2012).

2.3 ICT INTEGRATION IN EDUCATION

The presence of ICT has necessitated different approaches to 21st century education where the learning is seen as flexible, creative, challenging, and complex (Kereluik, Mishra, Fahnoe, & Terry, 2013). In order to succeed in life, career, and citizenship, students require knowledge and skills that include critical thinking, communication, collaboration, and technology (AACTE & Partnership for 21st Century Skills, 2010). Sir Ken Robinson (2010) argued that technology, with support from talented teachers, is

likely to revolutionise education. To transform teaching and learning, technological tools are considered crucial because they can accelerate students' deep learning, developing the attributes: character education; citizenship; communication; critical thinking and problem solving; collaboration; and creativity and innovation (Fullan & Langworthy, 2013).

ICT integration enables students to use technology in three different ways that transform learning: as an authentic context to support learning by doing; as a social medium to support learning by conversing; and as an intellectual partner to support learning by reflecting - which transforms pedagogical practices as well (Howland et al., 2012). Hence, there are a wide range of benefits that can result from the integration of ICT in education.

First, learning and teaching is transformed when ICT is used as a pedagogical tool with a constructivist approach (Tanti & Matekja, 2008). This occurs because using ICT tools can produce meaningful learning that is characterised by active, constructive, cooperative, collaborative, conversational, authentic, and intentional (Howland et al., 2012). The ultimate reward students in integrating ICT is that it enables them to take the lead and assume more active roles in their own learning (Tanti & Matekja, 2008). Integration of ICT with theoretically sound approaches has the power to develop students' ability to solve complex and authentic problems (Herrington & Kervin, 2007).

Second, the available choice of *what, how, when, and where* learning happens has been broadened by the emergence of ICT tools. Oliver (2003) argued that the use of a multitude of ICT tools creates learner-centred education where learning can be flexible and take place anywhere and anytime. For example, McCarthy (2010) experimented with the social networking tool *Facebook* for blended learning in which first year tertiary Australian students collaborated with students from other countries. The results were very positive, not only was the teaching engaging and effective, it was also found to be a useful tool for student assessment as well.

Third, digital tools can support authentic and meaningful learning, allowing the student learning to be active, collaborative, and constructive, in a real life problem solving context (Howland et al., 2012; Lombardi, 2007). Such benefits afforded by ICT mesh with the 21st century educational paradigm where education is about creating and inventing (Prensky, 2007).

Fourth, ICT motivates students thus playing a crucial role in their learning. Social learning theory (Bandura, 1971) asserts that learners have strong motivational effect if

something they learn has value. The use of ICT motivates students to learn because it enhances their learning experience through the use of innovative tools to which they can relate (Coates & Friedman, 2009; Sadaf, Newby, & Ertmer, 2012).

Fifth, the benefit of using ICT tools is that they are powerfully engaging thinking tools (Mishra, Yadav, & The Deep-play Research Group, 2013). For example, blogs are a good platform for students to maintain an ePortfolio. The asynchronous nature of the ePortfolio allows students more time to reflect and share their thoughts and ideas with peers.

However, the benefits of ICT described previously are likely to be only brought to fruition if ICT is adopted as an agent of change for education. This point was raised by Watson (2001) who argued that simply making ICT available does not change anything substantial in teaching and learning. According to Watson (2001), ICT can be a tool for change in teaching and learning only when students stop learning ICT in isolation; when teacher-centred teaching stops; if teachers are willing to adopt change; and if teachers are not techno-phobic. Watson's (2001) main argument is that both pre-service and in-service teachers need to be equipped with pedagogical skills necessary for teaching and learning using ICT where pedagogy guides what ICT is to be used and not the other way around. In such instances, the TPACK framework (see, Section 2.7) provides a useful guide as it reminds educators of the various types of pedagogical knowledge (for example, Technological Pedagogical Knowledge and Technological Pedagogical and Content Knowledge) required for the successful integration of ICT in educational contexts.

To conclude, when used with sound pedagogical approaches ICT can be a great tool for student engagement and thinking, resulting in meaningful learning (Howland et al., 2012; Lombardi, 2007). The effective use of ICT helps improve education because appropriate integration ICT supports a situation where "teachers teach better and students learn better" (Bahr, Shaha, Farnsworth, Lewis, & Benson, 2004, p. 88).

2.4 ICT INTEGRATION IN PRE-SERVICE TEACHER EDUCATION

ICT has fundamentally changed the educational paradigm because 21st century learning is about creating and inventing, using ICT tools and sharing creations with others (Prensky, 2007). This makes learning to integrate ICT during pre-service teacher education training all the more critical.

Repurposing ICT tools in education has the potential to fundamentally change the nature of teaching and learning (Koehler & Mishra, 2009a). ICT acts as an enabling force "to communicate, learn, share, collaborate and create, to think and solve problems, to manage their work to take ownership of their lives (Vockley, 2007, p. 6). It is critical to convince pre-service teachers that using ICT helps them to teach better and helps their students to learn better (Bahr et al., 2004). In order to achieve better ICT integration in schools, the groundwork must begin in pre-service teacher education (Teo, 2008). There are five reasons why pre-service teachers should learn how to integrate ICT into their teaching during their pre-service teacher training.

First, pre-service teachers usually come with experiences and beliefs based more on traditional teacher-centred teaching. Pre-service teachers need to be provided with adequate opportunities to examine their old beliefs and experience and adequate experiences of more ICT-enabled constructivist teaching pedagogy (Lim, 2013). Hence, it is crucial that pre-service teacher education programmes prepare future teachers to take on more constructivist-based learning approaches (Sang, Valcke, van Braak, & Tondeur, 2009).

Second, pre-service teachers with strong constructivist teaching beliefs, higher teaching efficacy, and ICT self-efficacy, and who possess positive attitudes towards ICT are more likely to adopt ICT integration in their teaching (Sang et al., 2009). In addition, Ertmer and Ottenbreit-Leftwich (2010) argued that existing culture plays an important role in determining whether teachers are likely to integrate ICT. This is because if the innovative ideas of ICT integration deviate from their current practices then the likelihood of accepting such new ideas are limited.

Third, the myriad of ICT tools available to both students and teachers have changed the way teaching and learning are being practised. Unfortunately the situation is that in many cases ICT usage is limited to students' lives outside school (Fullan, 2013). This is the reason why it is important to introduce ICT in pre-service teacher education. If teachers are expected to integrate ICT, they need to learn when they are in pre-service teacher training. Since students of 21st century have no specified learning place or time, learning can happen beyond four classroom walls (Fullan, 2013).

Fourth, ICT enhances the quality of education by helping teachers to perform their job more effectively, as well as helping students to learn more effectively (Goktas, Yildirim, & Yildirim, 2009). It is crucial that pre-service teacher education programmes prepare pre-service teachers for effective ICT integration (Goktas et al., 2009) because

achieving educational goals of effective ICT integration requires equipping fresh graduating pre-service teachers with adequate ICT integration skills, which can be identified by frameworks such as TPACK (Albion, Jamieson-Proctor, & Finger, 2011).

Fifth, ICT used with appropriate pedagogical approaches promotes higher order thinking that is necessary to develop 21st century skills. Lambert and Gong (2010) argued that pre-service teachers will be motivated to use ICT if they are provided with opportunities to develop such a philosophy for ICT integration right from the beginning of their the pre-service teacher training.

In the Bhutanese, pre-service teacher education context, there have been very few studies examining the use of ICT. Kinley (2010) studied e-learning awareness and the competencies of pre-service teachers and lecturers at Paro College of Education. This study examined areas related to access to computers for both pre-service teachers and lecturers; the skills and competencies of pre-service teachers and lecturers in using technology; and challenges related to slow Internet speeds. Kinley's study revealed that lecturers, while having access to computers, lacked the necessary competencies in using ICT. Pre-service teachers on the other hand, were constrained by limited opportunities to access to ICT and slow Internet speeds making it difficult for e-learning activities.

Another study (Kinley, Zander, Georgsen, & Choeda, 2013) on the integration of ICT at Samtse College of Education sought to both understand how ICT was being used by lecturers and to identify the factors that either influenced or impacted lecturers' use of ICT. This study revealed that, for lecturers, ICT was an effective lesson delivery tool. However, the study also found that lecturer motivation to use ICT for teaching was low due to resource constraints, lack of IT support, and an unstable Internet connection.

In conclusion, the importance of ICT in pre-service teacher training can be founded upon two research-based premises. First, pre-service teacher preparedness to integrate ICT at the teacher education colleges is important if pre-service teachers are expected to use ICT in their future classroom because during this time that they can be provided with exposure to and experience of ICT integration in specific content areas (Gill, Dalgarno, & Carlson, 2015). Second, one time professional development in-service programmes are not always effective (Fullan, 2013). Therefore preparing teachers at the teacher education colleges is critical (Burns-Sardone, 2014) and more sustainable in the

long term. The following two sections explore the enablers and inhibitors of ICT integration respectively.

2.4.1 Enablers of ICT integration

There are six main factors that enable pre-service teacher ability to effectively integrate ICT. The first enabler is a strong technology plan with clear visions of ICT integration that determine the kind of infrastructure and how to utilise or keep them up-to-date (Goktas et al., 2009; Tondeur et al., 2011). The second enabler is provision of ongoing professional developments for lecturers on the methods and approaches to integrating ICT (Tondeur et al., 2011). The third enabler is provision and maintenance of strong ICT infrastructure and it is important to provide adequate funds to continuously update and upgrade the ICT resource (Goktas et al., 2009). The fourth enabler is quality technical support as it provides necessary support such as fixing hardware, and keeping the software up-to-date (Goktas et al., 2009; Lambert & Gong, 2010; Tondeur et al., 2011). The fifth enabler is lecturers modelling ICT integration (Goktas et al., 2009). The sixth enabler is integrating ICT across the curriculum to provide pre-service teachers with relevant experiences to integrate ICT in specific content areas (Tondeur et al., 2011). Finally, it can be argued that ICT integration is more effective when teacher education institutions take responsibility, based on their vision and directions, to make themselves change agents by fostering these enablers (Tondeur et al., 2011).

2.4.2 Inhibitors to ICT integration

There is an ever-changing learning environment landscape in pre-service teacher education, caused partially by the large number of ICT tools available to both lecturers and pre-service teachers. Effective integration of ICT is more likely to be achieved by addressing potential barriers. In a study with Turkish pre-service teachers Goktas et al. (2009) identified three types of barriers to ICT integration. First, a lack of adequate professional training makes the integration of ICT into learning challenging, as ICT tools may not be utilised in pedagogically sound ways. Second, a lack of appropriate software and materials creates problems because the teacher educators and pre-service teachers may not have access to the most relevant software for effective integration of ICT. Third, access to sufficient suitable hardware is a barrier because lack of practice with ICT means that integration is less likely to become part of everyday teaching. Other studies (Loveless, Burton, & Turvey, 2006) have identified further challenges: lack of ICT integration skills; and lack of time to learn new or unfamiliar software

especially if ICT skills are lacking. To help pre-service teachers learn to integrate ICT, it is important to consider enablers of ICT integration that will help to address these barriers. Finally, one of the critical inhibitors to ICT integration is the inequality related to those who can and those who are not able to afford ICT. This is typical referred to as the 'digital divide'. Angus, Snyder, and Sutherland-Smith (2004) have argued that the digital divide will continue to exist as long the issue is not dealt by considering the issue from a range of perspectives. In particular, recognising that not only those who are unable to have access to technology are at a disadvantage but also those who may have access to technology but do not know how to utilize it. According to Angus, et al. (2004), students from different socio-economic background can be both advantaged and disadvantaged at the same time. Furthermore, they argued that issues associated with the digital divide cannot be fully be addressed without also looking at the broader socio-political aspects of advantage and disadvantage.

2.5 LECTURERS MODELLING ICT USE

It is a well understood phenomenon that ICT enables students, informing them on how to learn, when to learn, where to learn, and aiding them in knowledge construction, thereby, making ICT an agent of change for education (Oliver, 2003). Thus, when pre-service teachers are learning about teaching, in particular about effective ICT integration, lecturers need to model effective integration of ICT in their day-to-day teaching. Research supports the premise that pre-service teachers need to learn skills and experience effective pedagogy during their initial teacher training if they are to put these skills into practice in their future classrooms. In this regard, it is crucial that an adequate amount of exposure to and modelling of how to integrate ICT takes place in the teacher education programmes; especially if the premise of the nature of the way we learn, is the way we are going to teach in future (Albion & Redmond, 2008).

Exposure to ICT integration in pre-service teacher education programmes has shown that graduates are more likely to integrate ICT if they are adequately exposed to ICT integration during their training (Steketee, 2005). Goktas et al. (2009) argued that it is very important that lecturers in teacher education programmes role model ICT integration for their students, if they expect them to integrate ICT in the future. Another study by on ICT integration demonstrated that although pre-service teachers understand the importance of ICT integration, they still need constant support and modelling on how to integrate ICT from their faculty members both while at the

teacher training institution and during teaching practice in the field (Choy, Wong, & Gao, 2008).

2.6 ICT INTEGRATION MODELS

Emergent digital ICT has become an indispensable part of both educators' and students' lives by changing the way teachers and students interact and learn in technology-rich environment (Baran, Chuang, & Thompson, 2011). For instance, ICT provides momentum for motivation to learn anywhere, anytime, and anyhow - to make learning better, different, more interesting, pleasant, and relevant (Punie & Cabrera, 2005). In order for teachers to facilitate learning using ICT, they need to understand the effectiveness and value of ICT-enabled learning to motivate them to use ICT tools (Punie & Cabrera, 2005). Meaningful integration of ICT in teaching and learning requires understanding of ICT, subject matter, pedagogy, and the manner in which these elements interact (Mishra & Koehler, 2006). To better understand the integration of ICT into teaching and learning, teachers need to have knowledge of different ICT integration models.

There are a range of models available to help teachers effectively integrate ICT into teaching including: ICARE (Hoffman & Ritchie, 1998), ASSURE (Smaldino, Russell, Heinich, & Molenda, 2005), TPACK (Mishra & Koehler, 2005), SAMR (Puentedura, 2006), and a generic model (Wang, 2008). These models provide useful guidelines for evaluating and integrating ICT into teaching and learning from various perspectives. For this study, the TPACK and SAMR models were considered the most appropriate frameworks primarily because they are both widely used in both in-service and pre-service teacher education programmes. TPACK identifies the different knowledges required for effective integration of ICT while SAMR provides a guide and lens to assess how ICT is being utilised.

2.7 TPACK FRAMEWORK

The initial approach to using ICT in teaching and learning comprised learning ICT skills separately from the subject content and the pedagogy (Baran et al., 2011). Today practice demands situating teacher knowledge necessary for effective integration of ICT in order to equip teachers with a more interconnected knowledge that is geared toward student learning in varied areas: technological, pedagogical, and content (American Association of Colleges for Teacher Education, 2008). The TPACK framework achieves this aim.

2.7.1 Composition of TPACK Framework

Pedagogical Content Knowledge (PCK) was first proposed by Shulman (1986) as a special kind of knowledge that teachers require for effective teaching. This framework was developed at a time when the use of ICT was not common in teaching. Greater availability of ICT to both students and teachers created the need for incorporating technology into Shulman's (1986) PCK construct. In response, Mishra and Koehler (2006) proposed Technological Pedagogical Content Knowledge (TPCK), which is defined as a special kind of knowledge required for effective integration of technology in teaching and learning. The acronym later became 'TPACK' by adding the vowel 'A' to make pronunciation more convenient (Mishra, 2012). TPACK is a useful framework that informs teachers about the kind of knowledge they require to achieve effective ICT integration and how they might develop such knowledge (Baran et al., 2011). The TPACK framework comprises the seven inter-related types of knowledge (Figure 2.1) as discussed below.

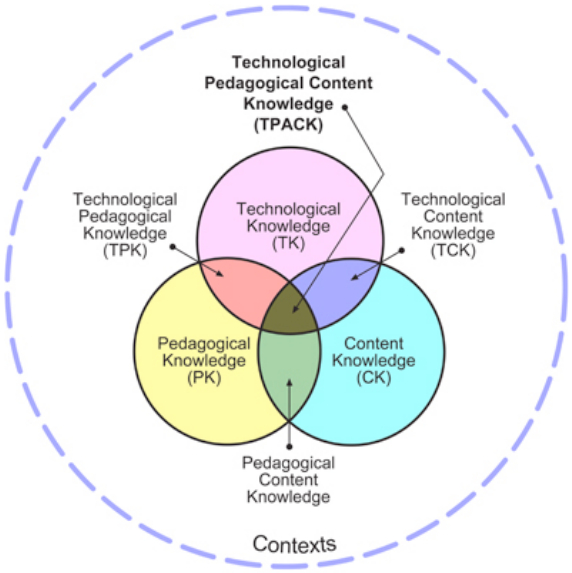


Figure 2.1. Technological Pedagogical and Content Knowledge

Source: https://upload.wikimedia.org/wikipedia/commons/5/5f/Tpack.jpg

Technological Knowledge (TK)

TK includes knowledge of low-tech technology, such as paper and pencil through to digital technology, such as the Internet, digital video, interactive whiteboards, and software programs (Schmidt, Thompson, Mishra, Koehler, & Shin, 2009). This knowledge also includes understanding how to use computer software and hardware, presentation tools such as document presenters and projects, and other technologies

used in the context of education (Koehler, Mishra, Akcaoglu, & Rosenberg, 2013). Importantly, TK is the ability to adapt and learn new technologies (Koehler, Mishra, Akcaoglu, et al., 2013) and is considered a specific kind of knowledge involving knowing both how to use technology and how to repurpose it for effective teaching and learning (Mishra, Koehler, & Kereluik, 2009). However, one problem is that technology is always in a state of flux, so, what constitutes new technology today becomes obsolete tomorrow, and hence it is difficult to provide a clear definition of TK (Mishra et al., 2009).

Content Knowledge (CK)

CK is knowledge about a specific subject matter that is to be taught or learnt. CK requires teachers to have a deep understanding of the subject they teach. For instance, the deep subject knowledge in science may comprise knowledge of scientific facts and theories, scientific methods, and evidence based reasoning, while in arts deep subject knowledge might include knowledge of art history, famous paintings, sculptures, artists and their historical context including the knowledge of aesthetic and psychological aspects for evaluating art (Koehler & Mishra, 2009b).

Pedagogical Knowledge (PK)

PK is a set of skills that teachers need to develop to manage and organise teaching and learning activities to meet intended learning outcomes (Koehler, Mishra, Akcaoglu, et al., 2013). PK encompasses teacher knowledge about how students learn, general classroom management skills, lesson planning, assessment, and knowledge about different theories of learning such as cognitive, social, and developmental theories that are applied in classrooms (Koehler & Mishra, 2009b).

Pedagogical Content Knowledge (PCK)

PCK is the knowledge teachers need to be able to interpret the subject matter, uncover numerous techniques to represent it, and adapt and customise it based on students' prior knowledge. When teachers possess such knowledge transformation of subject matter transpires (Shulman, 1986). PCK is the core of teaching, learning, curriculum, assessment and reporting (Koehler & Mishra, 2009b) PCK goes beyond being a content expert or just knowing general pedagogy, to possessing understanding of the unique interplay between content and pedagogy (Koehler, Mishra, Akcaoglu, et al., 2013).

Technological Pedagogical Knowledge (TPK), as argued by Koehler, Mishra, Akcaoglu, et al. (2013), identifies the mutual relationship between technology and pedagogy. This

knowledge aids in understanding the manner in which technology assists in achieving certain pedagogical goals. Hence, TPK is an understanding of how teaching and learning can change when a certain technology is used in particular ways (Koehler & Mishra, 2009b).

Technological Content Knowledge (TCK)

TCK is knowledge of how content and technology relate to each other in teaching and learning. According to Mishra and Koehler (2006), teachers need to understand the manner in which the content they teach is changed by the use of technology. For instance, the manner in which a mathematics teacher presents content is changed by the use of simulation software where the software emulates the actual mathematical procedure and changes the way students learn mathematical concepts (Koehler & Mishra, 2009b; Mishra & Koehler, 2006). Hence, TCK is an "understanding of the manner in which technology and content influence and constrain one another" (Koehler & Mishra, 2009b, p. 65). Teachers need to know not only the subject matter they teach but also they must possess a deep understanding of how subject matter can be transformed using technology. TCK helps teachers to use appropriate technology to enhance the content that is being taught (Young, Young, & Shaker, 2012).

Technological Pedagogical and Content Knowledge (TPACK)

TPACK is a teacher knowledge formed by complex interactions among three bodies of knowledge: content, pedagogy, and technology. The interaction of these bodies of knowledge, both in theory and practice, produces the types of flexible knowledge required for successful integration of technology into teaching.

TPACK is the basis of effective teaching with technology, requiring an understanding of the representation of concepts using technologies; pedagogical techniques that use technologies in constructive ways to teach content; knowledge of what makes concepts difficult or easy to learn and how technology can help redress some of the problems that students face; knowledge of students' prior knowledge and theories of epistemology; and knowledge of how technologies can be used to build on existing knowledge to develop new epistemologies or strengthen old ones.

Development of TPACK by teachers is critical in effective teaching with technology (Koehler, Mishra, & Cain, 2013) because deep knowledge of how ICT can be used to access and process subject matter (TCK) and understanding of how ICT supports and

enhance learning (TPK) in combination with PCK (Teaching Teachers for the Future, 2011) is the root of the TPACK knowledge.

2.7.2 Approaches to TPACK development

TPACK has gained considerable attention over the years. There are an increasing number of studies undertaken on TPACK. The critical question is how do teachers acquire an operational understanding of the complex relationship amongst content, pedagogy, technology, and context that is critical to teachers' TPACK development (Harris, Mishra, & Koehler, 2009)? This question is particularly important because teachers have begun to recognise and acknowledge the complexity of TPACK (Hofer & Harris, 2010). Teaching technological skills in isolation is likely to create a *technocentric* situation (Papert, 1990) where technology becomes the main focus as opposed to using technology for effective teaching. Although learning technological skills is important for effective teaching, it is not sufficient because it does little to help teachers to develop an understanding of how technological tools may be used to enhance teaching (Harris et al., 2009).

According to Guzey and Roehrig (2009), there are two important factors for the successful development of TPACK. First, the context in which teachers work is of significant influence. It is important for teachers to have access not only to technological tools but also to support in building community that enables teacher TPACK development. Second, TPACK development is largely dependent on teachers' pedagogical reasoning. For instance, if teachers' belief are that technology has the capacity to engage and make learners active, and the teachers are likely to materialise their beliefs by putting them into practice, termed TPACK-practical (Yeh, Hsu, Wu, Hwang, & Lin, 2013).

2.7.3 Issues with TPACK

While TPACK has found a place of importance in different levels of educational curriculum from K-12 through to pre-service and in-service teacher education, it has also created some challenges. Graham (2011) identified three issues with the TPACK framework. First, since TPACK is built on PCK which itself lacks theoretical clarity, researchers must understand PCK first in order to understand and measure TPACK. Second, TPACK lacks construct clarity as all researchers must be able to understand the construct in depth without any confusion, in a way which is accessible to not only the elite few but all researchers. Third, reviewing the literature, demonstrated that

scholars differed in their definition of TPACK and its components. Graham (2011) argued that the definition and the scope of technological knowledge has to be very precise as TPACK is built on PCK by adding a technology component and more importantly a precise definition is crucial for a coherent theory for which TPACK lacks.

2.8 SAMR MODEL

The mere presence of technology does not improve teaching and learning unless technology is used appropriately with good instructional approaches (Andrei, 2014). It is therefore crucial to not only use technology to substitute what was done previously but use it to enhance and transform student learning - which does not always happen (Marcovitz & Janiszewski, 2015).

In the Substitution, Augmentation, Modification, and Redefinition (SAMR) model (Figure 2.2) Puentedura (2006) challenged teacher educators to question whether their lessons are truly transformed by using technology.

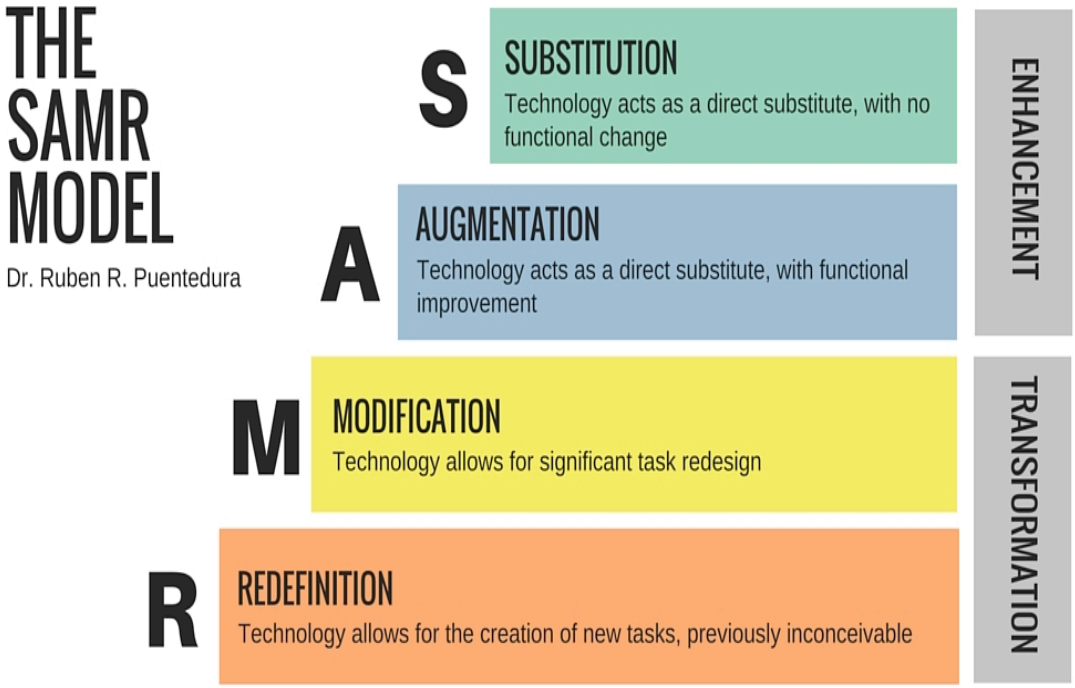


Figure 2.2. SAMR model

Source: https://upload.wikimedia.org/wikipedia/commons/5/5e/The_SAMR_Model.jpg

The SAMR model informs teachers how to assess their use of technology and how to use technology to enhance or transform teaching and learning. The SAMR model is a hierarchical taxonomy, which progresses through four levels corresponding to how

technology is used in teaching. *Substitution*, the first level in the *Enhancement* domain (Figure 2.2), is where technology is just used to replace the old technology. For example, using word processing software to replace a writing task with no apparent functional change in the way the lesson is presented. This is an advantage over the old technology only in terms of efficiency in the presentation. The next level, *Augmentation*, is where there is some added value from using technology. For instance, using enhanced editing features of a word processor, such as copy/paste and track change features, enables some functional change. These first two levels of the SAMR model only play an enhancement role in the teaching and learning process. Classroom activities remain essentially the same except that use of technology enhances the way the activities are carried out but with no fundamental change to the process of teaching and learning (Parsons, 2013).

The next two levels of the SAMR model require teachers to redesign the teaching and learning process through the use of ICT tools, enabling the nature of the teaching and learning process to change significantly. *Modification*, the first level of the *Transformation* domain (Figure 2.2), is where there is significant redesign of the task through the incorporation of ICT in the teaching and learning process. For instance, sharing on wikis and blogs could enhance a word processing task. The fourth level, *Redefinition* is where there is a significant redesign of the learning task which is previously impossible without ICT. For instance, using Minecraft to create personalised games.

With the increasing popularity of mobile devices amongst students, the SAMR model is regarded as a useful framework to evaluate mobile learning as well (Romrell, Kidder, & Woods, n.d). A study by Burns-Sardone (2014) used the SAMR model in a case study based on Bring Your Own Device (BYOD) with pre-service teachers. The study investigated pre-service teachers' preparedness, proficiency, and innovation with smart phones. The model was used to inform how ICT should be used in teaching and learning. Further, Keane, Keane, and Blicblau (2013) argued that without knowledge of the SAMR model, teachers' ICT usage was mostly at the *Substitution* or *Augmentation* level. They argued that if students are to be prepared for 21st century skills it is critical that students' ICT usage is in the *Transformative* domain.

The SAMR model has proven to be a useful and effective framework for teachers to design, develop, and integrate ICT to transform student learning, leading to high student achievement and attainment of learning outcomes (Saliba, Rankine, & Cortez,

2013). Saliba et al. (2013) presented interesting examples of how SAMR model is being applied in teaching and learning situations involving different digital ICT such as blogs, twitter, Internet streaming, mind-mapping, discussion boards, video conferencing, screen capture, and audio recording.

The SAMR model has also found its place in engineering faculties to facilitate the development of symbolism and reasoning in digital teaching environments where pen-enabled technologies in engineering are utilised (Maclaren, Singamemni, & Wilson, 2012). This indicates the importance and utility of the SAMR model in higher education.

2.9 CHANGE MANAGEMENT PRACTICES IN EDUCATION

Applying new models, such as TPACK or SAMR, to effect change, is likely to be as difficult as implementing other changes in the teaching and learning process because, as Morrison (1998) explained, such changes require realignment of the existing values, practices, and outcomes of a system or an organisation. The need for change in education is brought about to a large extent by the fact that "professionals of 21st century think and act differently than those of previous centuries, due at least part to the radically different tools they use to perform their jobs" (Ertmer & Ottenbreit-Leftwich, 2010, p. 255). Morrison (1998) defined change as a dynamic process of development and growth that involves realignment of existing values, practices, and outcomes necessitated by both internal and external factors at the individual, group or institution level.

Specifically, change in education is dependent on various factors that need serious consideration before attempting to realise such change. At the centre of any educational change is the leadership of the organisation because without effective school leadership, large scale sustainable reform is not possible as a strong leader(s) are required for fundamental transformation of teaching profession (Fullan, 2002). There is the type of change that Fullan and Langworthy (2014) termed *Inherent change* that is "very efficient, reaches everyone, motivates from within, cultivates group ownership, and has built-in sustainability"(p. 48). They argued that under the right conditions, change in education can spread very swiftly and enable the transformation of the existing system in a very short period of time.

Ertmer and Ottenbreit-Leftwich (2010) argued that for success of any change in the teaching and learning system, it is important to consider four key variables without

which any proposed changes are unlikely to happen. The first variable, teacher knowledge, plays a critical role because unless teachers possess knowledge such as TPACK, they will not be able to change their ability to effectively integrate technology in the classroom. The second variable, teacher self-efficacy, is critical because if teachers do not have the confidence to effectively use ICT in a pedagogically sound manner then they will not use it at all even if they have good ICT skills. The third variable, teacher belief system with regard to their pedagogical practices, is vital. Teachers' beliefs need to change to become more constructivist in orientation, as it is the teachers with constructivist beliefs who tend to use ICT in a more meaningful way. The fourth variable, teacher culture, determines how easily teachers embrace change because it is less likely that teachers will embrace change if the proposed change deviates too much from their current values, beliefs, and practices. In addition to the above four variables, it is also important that a conducive environment is created to effect sustainable change in education (Fullan, 2002).

2.10 CHAPTER CONCLUSION

This chapter has presented the literature of relevance to the study. It has described the concept of Gross National Happiness (GNH) and explained the importance of the education domain as a cornerstone of the GNH-based developmental model. Reviewing the principles and values of GNH, the case has been made that an ICT integrated curriculum can bring many of these GNH principles and values to bear. The two integration models to be used as the theoretcial frameworks for the study, TPACK and SAMR, were presented and described. A number of potential enablers and inhibitors to ICT integration were identified. The next chapter examines the research methodology and describes the various facets of the research design informing the study.

CHAPTER THREE

METHODOLOGY

This chapter examines the research methodology and describes the various facets of the research design informing the study. The chapter is made up of six sections. The first section provides an overview of the Royal University of Bhutan and specific details pertaining to the research setting at Paro College of Education. The second section describes the selection of an appropriate research methodology. The third section explores in detail the nature of mixed methods as a research method. The fourth section examines the issues of validity and reliability. The fifth section describes the selection of appropriate research instruments, their protocol for administration and suitable analysis techniques. The sixth section provides a conclusion to the chapter.

3.1 RESEARCH SETTING

In this section the Royal University of Bhutan and Paro College of Education are described. This is followed by details concerning the specific research setting at Paro College of Education.

3.1.1 Royal University of Bhutan

The Royal University of Bhutan is the only university in Bhutan. It was established in accordance with a Royal decree on April 8, 2003. In 2014, the university comprised nine member colleges spread across the country. The nine member colleges comprised: two teacher education colleges; two engineering colleges; one business college; one language and cultural studies college; one college of natural resources; one general studies college; and one privately owned affiliated college. The nine Royal University of Bhutan colleges offer a variety of courses with most of the courses offered at undergraduate level only. In 2014, the undergraduate programmes offered included: Engineering, Language and Cultural Studies, Natural Resources, Information Technology, Mass Communication, Science, Maths, Arts, Environmental Science, Sustainable Development, Economics, Commerce, Business, and Teacher Training. Only three colleges offered postgraduate Diploma courses, a number of which were offered through distance education programmes. The only postgraduate Master of Education was offered at Paro College of Education through a distance education

mode, with other postgraduate diplomas in education being offered on campus in both colleges of education.

3.1.2 Paro College of Education

The Paro College of Education (PCE), one of the member colleges of the Royal University of Bhutan, was established in 1975 as a pre-school teacher training centre. It originally took the name *Teacher Training College and Demonstration School* because it had a demonstration school established inside the campus (Dorji, 2005). In order to meet the teacher shortage for general upper primary curriculum and Dzongkha (Bhutan's national language), the Teacher Training Centre and Demonstration School was upgraded to train teachers to teach upper primary classes and Dzongkha (Dorji, 2005). The new upgraded programme was the Primary Teaching Certificate for general subjects in all levels of primary curriculum, and the Zhungkha Teaching Certificate to teach the Dzongkha language.

The Bhutanese government upgraded the *Teacher Training Centre and Demonstration School* to the *National Institute of Education*. The first cohort of Bachelor of Education students were enrolled in 1999 in the new Bachelor of Education. The existing Primary Teaching Certificate and the Zhungkha Teaching Certificate programmes were phased out in 2003 (Dorji, 2005). This new Bachelor of Education programme at Paro College of Education specialised in training teachers to teach Dzongkha. The *National Institute of Education* was renamed the *Paro College of Education (PCE)* in 2004 when the Royal University of Bhutan initiated naming consistency across its member colleges.

By 2014, PCE was offering a number of pre-service and in-service teacher education programmes. Although the primary focus of Paro College of Education was to train Bachelor of Education (Primary) teachers, the college also offered Bachelor Education (Dzongkha) and Bachelor of Education (Secondary) programmes. Other programmes at PCE were: Postgraduate Diploma in Education (PGDE) in teaching Dzongkha; Diploma in Sport Education and Coaching; Bachelor of Education by in-service mode; and Master of Education in Educational Leadership. The modes of delivery of programmes at PCE are presented in Table 3.1.

Table 3.1. Modes of delivery of programmes at Paro College of Education

Programme	**Mode of delivery**
Bachelor of Education (Primary)	Pre-service on-campus In-service mixed mode
Bachelor of Education (Dzongkha)	Pre-service on-campus In-service mixed mode
Bachelor of Education (Secondary)	Pre-service on-campus
Postgraduate Diploma in Education (Dzongkha)	Pre-service on-campus
Diploma in Sports Education and Coaching	In-service mixed mode
Master of Education in Educational Leadership	In-service mixed mode

Note: Mixed mode – teaching via face-to-face and distance education.

Bachelor of Education Programmes (BEd)

The main focus of PCE was to train pre-service teachers in the BEd (Primary) programme to teach primary school subjects. There were also some pre-service teachers studying the BEd (Secondary) majoring to teach ICT in combination with a second teaching subject. While the BEd (Secondary) at PCE was offered only on-campus, the BEd (Primary) and BEd (Dzongkha) were offered both on-campus and by distance mode. The BEd (Primary) and BEd (Dzongkha) were designed for both general and Dzongkha in-service teachers who did not possess BEd qualifications. The BEd (Dzongkha) was designed to train teachers to teach Dzongkha and the pre-requisite for this programme was that the candidates had completed Higher Secondary at the Institute of Language Cultural Studies or advanced level Dzongkha (Rigzhung) from a Higher Secondary school.

Postgraduate Diploma in Education (Dzongkha)

This was a one year programme designed to prepare teachers to teach the national language, Dzongkha. This programme was offered to candidates who had majored in Dzongkha at the undergraduate level. The candidates usually came from two colleges of the Royal University of Bhutan - General Studies and Language and Cultural Studies - or from Buddhist universities in India.

Diploma in Sports Education and Coaching

This diploma is a two-year fulltime programme specifically designed for high school graduates who wish to become games and sports coaches in the Bhutanese school

system. Many sports coaches had been in the Bhutanese school system with no formal qualification in sports-related coaching and this diploma was designed to formalise the skills needed for this role.

Master of Education in Educational Leadership

This programme began as a joint venture with St. Francis Xavier University, Canada in 2003 and continued until 2006 when PCE took full responsibility for the programme. This was an in-service programme offered during the winter months when schools were on long winter holidays. Usually teachers were promoted to the position of principal with no leadership accreditation and thus formal training in the leadership skills required to run a school. This programme was designed to equip school principals with adequate leadership and managerial skills to effectively fulfil their role.

3.1.3 The Research setting at Paro College of Education

The study took place at the Paro College of Education, one of the member colleges of the Royal University of Bhutan. Although the main function of this college was to train primary pre-service teachers, the enrolled population also included secondary pre-service teachers majoring in teaching ICT and one other subject, such as Mathematics or English.

At the college, the learning environment infrastructure included: a library, sporting facilities, and computer laboratories supporting the learners. In order to encourage both lecturers and pre-service teachers to take advantage of ICT in their everyday work, the college had set up five computer laboratories, each with 30 computers with Internet connection. The college campus was connected by a Wi-Fi system to enable everyone at the college to take advantage of their own ICT devices. The college provided a laptop for each of the lecturers.

In 2014, there were 1215 pre-service teachers enrolled at the college and 71 lecturers delivering programmes. The gender mix of the pre-service teacher was 611 females and 604 males. The age of pre-service teachers ranged from 19 to 45 years, however, the majority were aged 19 to 23 years. The gender mix of the lecturers was 15 females and 56 males. The age of lecturers ranged from 35 to 50 years. All lecturers each taught more than one subject. The majority of lecturers had ten years or more experience teaching at the college.

3.2 SELECTING THE RESEARCH METHODOLOGY

The selection of an appropriate research methodology, which is best suited to the research setting, is critical to effectively address a study's research questions. Appreciating and understanding the methodological choices informs the researcher about not only the method or methods employed but also the rationale why a particular method is preferred over other methods.

The theoretical perspectives and epistemological stances taken by the researcher primarily influence the choice of research methodology. Gray (2004) argued that the choice of methodologies is often determined by whether the researcher is inclined towards an inductive or deductive approach. The choice of research methodology is also usually dependent on the ontological and epistemological perspectives of the researchers (Jackson, 2013).

3.2.1 Research philosophy

All research is based on certain underlying assumptions about what constitutes valid research and which research methods are appropriate (Myers, 1997). It is imperative that researchers understand "the philosophical foundation and assumptions about human experience and knowledge on which experimental-type, naturalistic research, and more recently, mixed methods tradition are based" (DePoy & Gitlin, 2011, p. 24). An understanding of the philosophical foundation has two benefits (DePoy & Gitlin, 2011). First, the researcher becomes more skilled in directing the research process and selecting specific methods to use and combine. Second, the researcher becomes better able to recognise that "knowledge" is shaped by the way one frames a research problem and the strategies that are employed to acquire, analyse, and interpret information. Philosophical worldviews can be categorised into four types: Postpositivism, Constructivism, Advocacy/Participatory, and Pragmatism. These are summarised in Table 3.2.

Table 3.2. Philosophical worldviews

Postpositivism	**Constructivism**
Determination	Understanding
Reductionism	Multiple participant meanings
Empirical observation and measurement	Social and historical construction
Theory verification	Theory generation
Advocacy/Participatory	**Pragmatism**
Political	Consequences of actions
Empowerment issue-oriented	Problem-centred
Collaborative	Pluralistic
Change-oriented	Real-world practice oriented

Source: Creswell (2009)

The four different philosophies serve a variety of purposes (Creswell, 2009). Postpositivists seek theory verification. They are more inclined towards quantitative than qualitative research. Data in the positivist paradigm primarily are collected through experiments, quasi-experiments, tests, and scales although qualitative methods can be utilised (Mackenzie & Knipe, 2006). Constructivists believe in the subjective nature of reality where knowledge is socially constructed in relation to the social context, the person. The goal of the constructivist researcher is to seek theory as opposed to test theory and the research is qualitative in nature (also called Interpretivist). The researcher relies predominantly on the views and opinions of the participants' social context. Data gathering tools predominantly consist of interviews, observations, document reviews, and visual data analysis (Creswell, 2007, 2009; Mackenzie & Knipe, 2006). Advocacy/Participatorists pays more attention to the importance of addressing the social issues of the marginalised groups in the society. Their goals are concerned with bringing about reform and change by addressing the issues of marginalised groups (Creswell, 2007, 2009; Creswell & Plano Clark, 2011). This worldview is particularly associated with qualitative research but can be used as foundation for quantitative research to address injustice such as "oppression, domination, suppression, alienation, and hegemony" (Creswell, 2007, p. 21).

Pragmatists seek to solve real-world problems through a pluralistic approach, which allows researchers flexibility in their research approach, methodology, method and data. Pragmatism as a worldview "arises out of action, situation, and consequences rather than antecedent conditions (as in postpositivism)" (Creswell, 2009, p. 10) and so

in research is concerned with what works as a solution to the problem at hand. Creswell (2009) argued that pragmatism puts emphasis on the research problem and employs approaches most suitable to understanding the problem as opposed to focusing on methods. Thus a pragmatic philosophical approach allows a researcher the freedom to use any methods/techniques and procedures associated with quantitative and/or qualitative data to address the research questions.

Pragmatism as a philosophical choice for the study

For the researcher of this study, pragmatism had the potential to open the door to multiple methods, different assumptions, and different forms of data collection and analysis. The rationale for choosing to use pragmatism as a philosophical worldview for this study was well informed by Creswell (2009) who provided six reasons why pragmatism is a suitable philosophical basis for mixing research methods.

- Pragmatism is not committed to any one system of philosophy or reality.
- Pragmatists, as researchers, have the freedom to choose methods, techniques, and procedures that best suits the needs and purposes of the researcher.
- Pragmatists do not see the world as an absolute entity and therefore, seek methods and approaches to collect and analyze data that best help understand the problem.
- Pragmatists believe truth is what works at the time. It is based in a duality between reality independent of the mind or within the mind. The researcher employ mixed methods approach as this can help better understand the research problem.
- Pragmatists agree that the research always occurs in social, historical, political, and other contexts. The researcher may use a theoretical lens (Postmodern) that reflects social justice and political aims.
- Pragmatists believe in an external world independent of the mind, as well as the world lodged in the mind.

For these reasons, a pragmatic philosophical view was considered the most suitable for the study context. Although a pragmatic approach allowed the researcher the freedom to use any methods/techniques and procedures associated with qualitative or quantitative data, the researcher needed to recognise that every method has its limitations and different methods can be complementary. In the next section, research methodologies are considered to inform the choice of methodology most suitable for the pragmatic philosophical view taken in the study.

3.2.2 Research methodology

Research embedded in complex educational contexts requires negotiation and planning to effectively meet the research aims. In this study the research questions presented in Chapter One were taken to the lecturers at Paro College of Education and used as the platform to negotiate appropriate methodologies.

Further influencing the choice of methodology was the caveat from the college that the timeframe for the data collection be restricted to a six-week window early in the teaching semester from the beginning of August to mid-September. This was the time preferred by lecturers and considered the least disruptive for the pre-service teachers.

To frame the study three methodologies were considered during these discussions: Action Research, Case Study, and Mixed Methods. The strengths and weaknesses of each were debated, resulting in a recommended methodology for the study.

Action research

Action research, also known as practitioner-based research (McNiff, 2002), is a process in which the practitioner examines their own educational practice systematically. Carefully following the procedures of research (Farrance, 2000), action research aims to determine whether things are happening the way one has anticipated (McNiff, 2002). According to Kemmis (2007) action research aims at changing three things: practitioner's *practices,* their *understanding* of their practices, and the *conditions* in which they practice. Since this disciplined inquiry of action research takes place within the practitioner's context, it leads to informing and changing one's own practices in the future (Farrance, 2000).

Action research in an educational setting can be categorised into four types (Farrance, 2000): *Individual teacher research*, *Collaborative action research*, *School-wide action research*, and *District-wide action research*. The four types of action research are presented in Table 3.3.

Individual teacher action research involves studying single classroom issues such as classroom management and teacher instructional practices.

Collaborative action research is usually out by a group of teachers who have common issues that need to be addressed. These issues can be classroom or departmental level.

School-wide action research may involve addressing issues that are common to all at a school or institution. School-wide action research may focus on study of how to best involve the local community leaders for student learning, for instance.

District-wide action research can focus on the issues that are common to schools across the district or organization. This type of action research is resources intense but derives maximum reward.

Table 3.3. Types of educational action research

	Individual teacher research	**Collaborative action research**	**School-wide action research**	**District-wide action research**
Focus	Single classroom issue	Single classroom or several classrooms with a common issue	School issue, problem, or area of collective interest	District issue Organizational structures
Possible support	Coach/mentor Access to technology Assistance with data organization and analysis	Substitute teachers Release time Close link with administrators	School commitment Leadership Communication External partners	District commitment Facilitator Recorder External partners
Potential impact	Curriculum Instruction Assessment	Curriculum Instruction Assessment Policy	Potential to impact school restructuring and change Policy Parental involvement Evaluation of programs	Allocation of resources Professional development activities Organizational structures Policy
Side effects	Practice informed by data Information not always shared	Improved collegiality Formation of partnerships	Improved collegiality, collaboration, and communication Team building Disagreements on process	Improved collegiality, collaboration, and communication Team building Disagreements on process Shared vision

Source: Farrance (2000).

Scholars portray action research differently. To some scholars (McNiff & Whitehead, 2002) action research is cyclic while to others (Kemmis & McTaggart, 2007) it is spiral. However, the nature of action research is that it takes place in a natural setting and involves series of an iterative process of *Plan*, *Act & Observe*, and *Reflect* and then *Act*

again in the light of what one found in one phase and the process continues (Kemmis & McTaggart, 2007). Action research is carried out in a naturalistic setting in order to create techniques of "planned change, classroom problem solving, and college and university development and improvement" (Schmuck & Stevenson, 2010, p. 17).

This study was concerned with addressing issues associated specifically with the Paro College of Education so the school-wide action research type would have been most appropriate because it focuses on issues that are common to all in a particular organization. The school-wide type of action research involves people from within the organization working with external researcher(s) to address identified issues. The iterative process (*Plan, Act, Reflect, and Act*) of action research would have potentially informed the study if action research had been utilised as the methodology. However, action research was ultimately considered not appropriate for this study for two reasons. First, the iterative process requires a considerable amount of time to complete and this was not available within the study context. Second, action research implies the researcher is seeking to propose change for improvement, which was not the case in the context of the study.

Case study

Case study is defined as "an empirical inquiry about a contemporary phenomenon (e.g., a "Case"), set within its real world context-especially when the boundaries between phenomenon and context are not clearly evident" (Yin, 2009, p. 18). A case may comprise person, child in the classroom, class, group, school, community, program, specific policy, teacher, principal or event (Merriam, 1998; Mertens, 2010). Case studies can be single or multiple, and each of these can be holistic or embedded within subcases, resulting in four case study designs as represented in Figure 3.1. In a situation where the study involves only one organization then it would be a single holistic embedded case study. However, if the study involved two or more organizations with similar issues then multiple embedded case studies are appropriate.

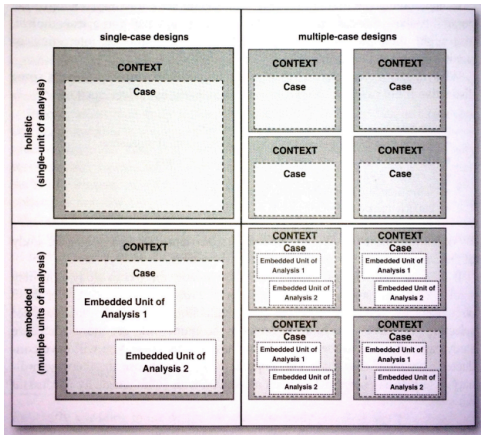


Figure 3.1. Types of case studies

Source: (Yin, 2012).

Since the study involved studying one organisation comprising pre-service teachers and lecturers at Paro College of Education, an embedded single case study with more than one unit of analysis present (Yin, 2009) was considered appropriate. However, case study was ultimately considered not suitable for this study because as a research method it has not gained widespread recognition and is often considered as the last choice by researchers (Yin (2012).

Mixed methods

Mixed methods, as a research methodology, is a combination of methods, philosophy, and research design orientation (Creswell & Plano Clark, 2011). Mixed Methods has risen rapidly in popularity as a research methodology in the first decade of the twenty first century and is often referred to as the third methodological movement (Cameron, 2011). "Certainly in the 21st century Mixed Methods is a significant movement in research methodology in the United States and around the world" (Plano Clark & Creswell, 2008, p. 1).

The core characteristics of mixed methods research, according to Creswell and Plano Clark (2011), are adequately fulfilled in a research process where the researcher:

- collects and analyses persuasively and rigorously both qualitative and quantitative data (based on the research questions);
- mixes (integrates or links) the two forms of data concurrently by combining them (or merging them) sequentially by having one built on the other, embedding one within the other;

- gives priority to one or both forms of data (in terms of what the research emphasises);
- uses the procedures in a single study or in multiple phases of a program of study;
- frames these procedures within philosophical worldviews and theoretical lenses; and
- combines the procedures into specific research designs that direct planning for conducting the study.

Recommended methodology for the study

After considering all three methodologies, mixed methods was considered to be the most appropriate methodology to support this study for three main reasons. First, mixed methods allowed the collection of three types of data (survey, interview, and focus group) in parallel during the data collection phase and this was attractive due to the six-week time constraint negotiated with the lecturers. Second, mixed methods provided flexibility to adapt and respond to the research setting. Third, using mixed methods helped overcome any biases that may have occurred using just a qualitative or quantitative method.

Having selected mixed methods as the methodology, the researcher had to develop a pragmatic, ethical and achievable research plan to collect rich data within the six-week research window which best suited PCE and the researcher. Planning discussions between the lecturers at the college and the researcher also resolved issues relating to access to research participants and the suitability of research instruments.

The outcome of the negotiation was that data collection should take place in the early part of the academic semester when participants are more readily accessible. This was for two reasons. First, most lecturers and pre-service teachers would be present in the college then as they go out for practical experiences later in the semester. Second, both lecturers and pre-service teachers would be not as busy earlier in the semester as there are less assessment commitments. Negotiations around the most appropriate and pragmatic tools to collect data to address the research questions within the negotiated time window led to the recommendation that survey, interview, and focus groups be used.

3.3 RESEARCH METHOD

The following explores in more detail the nature of mixed methods situating discussion among qualitative and quantitative research methods as a point of comparison and contrast. Further justification of the choice of mixed methods for the study is also provided. Each of these three research methods rest upon different ontologies (Cohen, Manion, & Morrison, 2011) and are elaborated below.

3.3.1 Qualitative research

Qualitative research is where researchers are "interested in understanding how people interpret their experiences, how they construct their worlds, and what meaning they attribute to their experiences" (Merriam, 2009, p. 5). Qualitative research 'virtually' does not deal with numerical data and instead utilises interviews, observations, videos, field notes, and open-ended questions (Johnson & Christensen, 2004; Verhoeven, 2011). Qualitative research takes place in a natural setting, is inductive in nature, uses multiple data sources, focuses on meanings participants hold, has a flexible research process, often uses theoretical lenses in the study, is interpretive, often develops a holistic picture of the problem, and involves data collection mainly by the researchers (Creswell, 2007). Qualitative research seeks to interpret and illuminate (Thomas, 2013) and is interpretive in nature (Thomas, 2013; Verhoeven, 2011). Qualitative research is linked to narrative research, phenomenology, grounded theory, ethnography, and case studies (Creswell, 2007).

Qualitative research could possibly have been a suitable method for the study because by employing such a method the researcher could gain intricate details about phenomena including feelings, thought processes, and emotions that are otherwise difficult to obtain through conventional methods (Strauss & Corbin, 1998). However, qualitative research is subjective and can easily be influenced by the researchers' own biases resulting in wrongly interpreting the reality (Ramona, 2011). This may result in important issues being overlooked (Choy, 2014). While qualitative research method would have been appropriate for this study, it was considered insufficient to adequately provide reliable unbiased data.

3.3.2 Quantitative research

Quantitative research is associated with positivist perspectives (Creswell, 2003) and involves quantification of information leading to making descriptions and inferences

(Thomas, 2013). Some common examples of quantitative research include: the quasi-experiment, and survey study (longitudinal or cross-sectional) using questionnaires or structured interviews to make generalisations from a sample to population (Creswell, 2003). One important advantage of quantitative research is that large amounts of data can be collected within a short timeframe. However, quantitative research lacks the ability to obtain in-depth descriptions of people's experiences. For the purpose of this study, quantitative research alone would not have provided adequate in-depth perspectives of the participants. However, quantitative methods would be useful as a means of verifying qualitative results. In fact, data from different methods complement one another and produce alternative perspectives giving a more complete picture (Denscombe, 2010). Therefore a mixing of both qualitative and quantitative research methods was considered the most appropriate for this study.

3.3.3 Mixed methods

Mixed methods is a research method for collecting, analysing, and mixing both quantitative and qualitative data at some stage of the research process within a single study, to better understand a research problem (Creswell, 2012). Mixed Methods may serve one or more of the following five different purposes (Greene, Caracelli, & Graham, 2008).

- *Triangulation*: seeks convergence, corroboration, and correspondence of results from the different methods.
- *Complementarity:* seeks elaboration, enhancement, illustration, and clarification of the results from one method using the results from the other method minimises the inherent biases of qualitative and quantitative research.
- *Development:* seeks to use the results from one method to help develop or inform the other method, where development is broadly construed to include sampling and implementation, as well as measurement decisions. This helps enhance the construct validity of the results by exploiting strengths of the inherent method.
- *Initiation:* seeks the discovery of paradox and contradiction, new perspectives of frameworks, the recasting of questions or results from one method with questions or results from the other method.
- *Expansion:* seeks to extend the breadth and range of inquiry by using different methods for different inquiry components.

Utilizing more than one research method exploits the strengths of one method to compensate for the weaknesses of another method (Denscombe, 2010). However, mixed methods is still not without problems. One problem is that a mixed methods approach is often applied without knowing *why* and *how* it is applied (Bryman, 2008). Conducting qualitative and quantitative research does not guarantee the method is genuinely mixed, as the genuine integration of qualitative and quantitative in mixed methods requires asking two critical questions (Bryman, 2008, p. 20). First, what is the extent of genuine mixing and second, what is the outcome of mixing we are aiming for? Addressing these two questions helps to explain the *why* and *how* of applying mixed methods.

3.3.4 Research design

The next consideration was identification of the optimal research design of data collection to best combine methods. There are six major types of mixed methods research design, as proposed by (Creswell & Plano Clark, 2011): *Convergent Parallel, Explanatory Sequential, Exploratory sequential, Embedded, Transformative, and Multiple phase*. These are examined next.

Convergent parallel or convergent design

Convergent parallel or convergent design is when the researcher uses both qualitative and quantitative strands concurrently. For example, a study may use surveys and interview at the same time on the same topic. Equal priority is given to each strand while keeping each strand independent during the analysis and mixing results only during the interpretation stage.

Explanatory sequential design or explanatory design

Explanatory sequential design or explanatory design occurs in two distinct interactive phases. This design starts with quantitative data collection and analysis to address the research questions. The second phase involves collection of qualitative data to help explain the initial quantitative results.

Exploratory sequential design or exploratory design

Exploratory sequential design or exploratory design uses sequential timing where the phase begins with qualitative data collection and analysis, and the priority is on the qualitative strand on the study. Based on the exploratory results the researcher

attempts to test or generalise the findings. In the interpretation stage the quantitative results builds on the results of the qualitative results.

Embedded design

Embedded design involves collecting and analysing both quantitative and qualitative data concurrently. In this design the researcher may add a qualitative strand within a quantitative design or vice versa. For example, researcher may add case study within a quantitative strand.

Transformative design

Transformative design shapes the research within the transformative theoretical framework. Decisions such as interaction, priority, timing, and mixing are made within the context of transformative framework. For example, the researcher may utilise quantitative data to uncover the stereotypes of female smokers from feminist perspectives and then explain these using the qualitative data.

Multiple design

Multiple design is generally used in "program evaluation to support the development, adaptation, and evaluation of specific programs" (p. 72). In this design the researcher combines both sequential and concurrent strands over a period of time during the study period. For example, researcher to help reduce the smoking rate of juveniles, the researcher might begin with a focus group to understand the impact of smoking from health perspective and then utilise this result to develop instruments to assess different attitudes across certain community.

3.3.5 Convergent Parallel Design

The characteristics of convergent parallel design meant that it was the design choice most suitable for this study. Considering the six-week window that was available to the researcher to collect both qualitative and quantitative data the choice of convergent parallel design was the most appropriate for two main reasons (Creswell & Plano Clark, 2011; Fetters, Curry, & Creswell, 2013; Wittink, Barg, & Gallo, 2006). First, this design allows both quantitative and qualitative data collection and analysis to take place concurrently, giving equal priority to qualitative and quantitative methods. Second, this design allows the researcher to compare and contrast the results of two strands of data at the interpretation stage, as depicted in Figure 3.2, so that qualitative results are corroborated with the quantitative results for the purpose of validation. The

merging of qualitative results and quantitative results at this interpretation stage helps to corroborate the findings of one data strand with another. This triangulation of methods allows the researcher to achieve a deeper understanding of the phenomena under study.

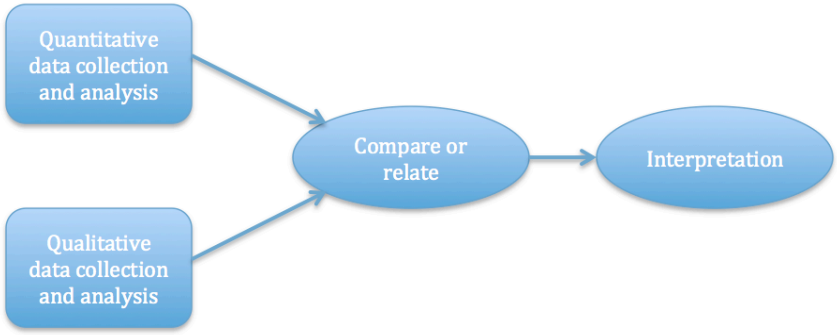


Figure 3.2. Convergent Parallel Design

Source: Creswell and Plano Clark (2011).

3.4 VALIDITY AND RELIABILITY

According to Morse, Barret, Mayan, Olson, and Spiers (2002, p. 14) "without rigor, research is worthless, becomes fiction, and looses its utility". It is crucial for educational researchers to possess a comprehensive understanding of validity, reliability, and generalisability as understanding these concepts improves the quality of research (Marland, 2014; Merriam, 1998). One way to approach validity and reliability is through a careful conceptualisation of the research, the manner in which data is collected, analysed, interpreted, and presented the findings (Merriam, 1998, p. 199).

3.4.1 Validity and reliability in qualitative research

In qualitative research the focus is more on validity than reliability (Creswell & Plano Clark, 2011). Both components of course contribute in terms of rigour in qualitative research.

Validity in Qualitative Research

Validity in qualitative research is about trustworthiness, utility and dependability that is being placed on the researcher and stakeholders (Bhattacherjee, 2012). Hence, validity is concerned with the meaningfulness of the research components (Drost, 2011) and this meaningfulness helps convince both researchers and participants that

the results of the study are right, accurate, and able to withstand scrutiny from other researchers (Marland, 2014). There are two types of validity: internal and external.

Internal validity is where one can draw correct conclusions which can be upheld and withstand the criticism that comes from other researchers. This kind of situation is prevalent in the research related to cause and effect (Verhoeven, 2011). There are a number of potential threats that jeopardise the accuracy and correctness of findings within a study (Rebar, Gersch, Macnee, & McCabe, 2011; Verhoeven, 2011).

- *Selection of participants:* biases due the way participants are selected.
- *Maturation:* dependent variable is affected by change of time.
- *History:* threat of outside factors.
- *Instrumentation:* for instance, if one adjusts the questionnaire during the research, then results may be skewed.
- *Mortality (drop outs):* sampling biases because of loss of participants.
- *Test-effect:* situations where the presence of researcher or participants' knowledge about their being the subject of the research influences the outcome.

External validity refers to the degree to which study results are generalisable or applicable to and across populations of persons, settings, times, outcomes, and treatment variations (Johnson & Christensen, 2004). External validity addresses the question of generalizability (DePoy & Gitlin, 2011). An examination of external validity focuses on threats or rival explanations that disallow the results of a study to be generalised to other settings or groups (Marland, 2014). One way to achieve external validity in a study is by checking whether the sample is a correct reflection of the population because sampling must resemble the population in relation to certain characteristics that are relevant to the study (Verhoeven, 2011).

Qualitative research validity is established by addressing four characteristics: *credibility, transferability, dependability,* and *confirmability* (Guba, 1981). *Credibility* refers to a situation when both the researcher and the user of research can place confidence in the truth of the findings of the study (Rebar et al., 2011). Guba (1981) suggested the following methods to address credibility.

- *Do prolonged participation at the study site:* which helps overcome distortions produced by the presence of researchers and to provide researchers with the opportunity to test biases and perceptions.

- *Do persistent observation:* to identify pervasive qualities as well as atypical characteristics.
- *Do peer debriefing:* to provide researchers with the opportunity to test their growing insights through interactions with other professionals. For instance, interactions with a *critical friend, a colleague, or significant other* willing or able to help reflect on the research process.
- *Practice triangulation:* to compare a variety of data sources and different methods with one another in order to cross-check data.
- *Collect referential adequacy materials:* such as documents, films, video recordings, audio recordings, artifacts, and other "raw" or "sliced-of-life" data items so that findings and interpretations can be later tested.
- *Do member checking:* to test the overall report with the study's participants before sharing it in final form.
- *Establish structural corroboration or coherence:* to ensure there are no internal conflicts or contradictions.
- *Establish referential adequacy:* to test analysis and interpretations against documents, recordings, films and the like that were collected as part of the study.

Transferability in qualitative research refers to the belief that qualitative study is context-bound and does not seek generalisation to a larger group or population (Guba, 1981). Guba (1981) suggested that in order to facilitate the development of descriptive, context-relevant statements, the researchers should do the following.

- *Collect detailed descriptive data:* that will allow comparison of a given context to other possible contexts to which transfer might be contemplated.
- *Develop detailed description of the context:* to make judgements about fittingness with other context possible.

Dependability, according to Guba (1981), is about the stability of the data. In order to address the issues related to dependability, Guba (1981) recommended the following steps.

- *Overlap methods* (similar to the triangulation process) where two or more methods are used so that the weakness of one method is compensated by the strengths of the other method(s).

- *Establish an audit trail* by having external people, such as a critical friend or significant other, examine the process of data collection, analysis, and interpretation.

Confirmability, the final characteristic used to address the trustworthiness of the qualitative inquiry, relates to the neutrality and objectivity of the data being collected. Guba (1981) argued that the confirmability could be addressed in two ways.

- *Practice triangulation:* where different data sources and methods are compared with one another to cross-check the data.
- *Practice reflexivity:* in which the researcher intentionally reveals underlying assumptions or biases that cause the researcher to formulate a set of questions in a particular way and to present findings in a particular way. Maintaining journals could be an example of practicing reflexivity.

Reliability in Qualitative Research

Reliability refers to the degree to which a test measures consistently whatever it measures (Marland, 2014). Generally, reliability in research design is based on the assumption that there is a single reality and that studying it repeatedly will produce the same results (Merriam, 1998). However, in qualitative studies, the researcher seeks to describe and explain the world as experienced by those who experience it. According to Merriam (1998), unlike the positivists, post-positivists do not believe the logic relies on repetition for the establishment of truth because measurements, observations, and people can be repeatedly wrong (Merriam, 1998). Hence, getting identical results from qualitative inquiry can be difficult because it is in narrative form and it is subjective in nature. The purpose of reliability in qualitative inquiry is not to aim for yielding the same results but instead achieving agreement that is based on the data collection process, the findings and the results being consistent and dependable (Zohrabi, 2013). According to Creswell and Plano Clark (2011), reliability in qualitative research plays a minor role except in some situations such as where there are different coders comparing their coding.

According to Merriam (1998), there are three different techniques to improve reliability in qualitative studies.

- *The investigator's position*: the researcher can explain the assumptions and theory behind the study; group being studied; the basis for selecting participants and a description of them; and the social context from which data were gathered.

- *Triangulation*: strengthens reliability because multiple methods of data collection and analysis are used.
- *Audit trail*: using this technique, the researcher describes in detail how data were collected, how categories were derived, and how decisions were made throughout the study.

3.4.2 Validity and reliability in quantitative research

In quantitative research it is important that the researcher understands that validity and reliability are fundamental indicators of good research (O'Leary, 2014).

Validity in Quantitative Research

In scientific study, the term validity is concerned with the degree to which the observations are measured or recorded as they are intended to be measured or recorded (Drost, 2011; Pelto & Pelto, 1978). Validity has the same purpose in both qualitative and quantitative research, which is to check on the quality of the data, the results, and the interpretation. Validity in quantitative research refers to whether the scores received from participants are meaningful indicators of the construct being measured (Creswell & Plano Clark, 2011). According to Creswell and Plano Clark (2011) there are three types of validity: *content, criterion-related*, and *construct*. Content validity seeks to determine whether items or questions are representative of possible items. Criterion-related validity, is concerned with whether the scores relate to some external standard such as scores on a similar instrument. Construct validity relates to checking whether items measure what they are intended to measure. In order to assess the validity of the study, researchers establish the validity of their instruments through content validity and of their scores through criterion-related and construct validity procedures (Creswell & Plano Clark, 2011).

In quantitative research, it is also essential that threats to both internal and external validity are reduced. Since internal validity deals with making conclusions based on the existence of cause and effect, threats that exist due to participant attrition, selection biases, and maturation of participants need to be addressed in the research design (Creswell, 2012). External validity in quantitative research is the extent to which the researchers can conclude that the results apply to the larger population, which is of the highest concern in survey research (Creswell & Plano Clark, 2011). According to Creswell and Plano Clark (2011), it is only when researchers have used the correct

procedures, such as selecting a representative sample, is there a guarantee that inferences can be drawn to other persons, settings, and past and future situations.

Reliability in Quantitative Research

Reliability in quantitative research design is based on the assumption that there is a single reality and that studying it repeatedly will produce the same result (Merriam, 1998). Therefore, reliability is the degree to which a test consistently measures whatever it measures. The more reliable the test, the more confidence one can have in the scores obtained from the administration of the test and that the test would essentially produce the same scores if it were to be readministered (Marland, 2014). Reliability is expressed numerically usually as a coefficient where a high coefficient implies high reliability (Marland, 2014). However, there is no test, which is perfectly reliable due to scores being invariably affected by errors of measurement resulting from a range of causes (Marland, 2014).

3.4.3 Validity and reliability in mixed methods

For mixed methods research triangulation can help enhance the reliability, construct validity, and overall method problems (Yin, 2009). There are four major types of triangulation (Patton, 2002): *Method triangulation*, *Triangulation of sources*, *Analyst triangulation*, and *Theory/Perspective triangulation* (see Table 3.4). Method triangulation, combining several methods of data collection, was the preferred form of triangulation for this study because it helps to overcome the inherent biases associated with using qualitative methods or quantitative methods separately.

Table 3.4. Types of triangulation methods

Type	**Description**
Method triangulation	Checking out the consistency of findings generated by different data collection methods.
Triangulation of sources	Checking out the consistency of different data sources within the same method.
Analyst triangulation	Using multiple analyst to review findings.
Theory/Perspective triangulation	Using multiple perspectives or theories to interpret the data.

Adapted from: Patton (2002)

Convergent Parallel Design, the chosen mixed method research design for this study, seeks to obtain different but complementary data on the same topic, where the

researcher gives equal value for collecting and analysing both quantitative and qualitative data to understand the research problem (Creswell & Plano Clark, 2011). In this regard, method triangulation, which seeks for convergence, corroboration, and correspondence from different methods (Green, 2008), was considered suitable for this convergent parallel design.

Validity in mixed methods

In mixed methods research, discussion on validity is in its infancy (Onwuegbuzie & Johnson, 2006). All methods have inherent biases and limitations and the use of only one method to study a given phenomenon risks producing biased and limited results. The results obtained by using two or more methods that have offsetting biases leads to converging or corroborating one another which enhances the validity of the study (Greene et al., 2008). Validity in Mixed Methods relates to stages of the research process: research design and data collection, data analysis, and interpretation of the findings (Onwuegbuzie & Johnson, 2006). Creswell and Plano Clark (2011) discussed validity issues in relation to three phases: data collection, data analysis, and interpretation of results. They argued that the mere fact that the data analysis technique in mixed methods involves merging or connecting data does not necessarily mean that validity is adequately addressed. Creswell and Plano Clark (2011) suggested ways to minimise the threat to the validity at each of the three phases.

First, there are threats to validity that arise during the data collection phase, including: drawing samples from different populations; drawing unequal sample sizes from different strands of the data; ignoring potential bias in a particular strand of data; drawing to types of data that do not address the same issue; and selecting inappropriate individuals. Such threats can be overcome by: using more than one data collection procedure; collecting data at the end of the data collection period; using larger qualitative samples or using smaller quantitative samples to minimise inequity in sample size; and addressing the same issue in both strands of the data collection.

Second, there are the threats to validity related to data analysis, including: using inappropriate approaches to converge data; making illogical comparison of two results of analysis; using inadequate data transformation techniques; and using inappropriate statistics to analyse quantitated qualitative data. Such threats can be overcome by developing joint displays with quantitative categorical data and qualitative themes or using other display configurations, finding quotes that match the statistical results; keeping data transformation straightforward, using procedures to enhance reliability

and validity of transformed scores; and examining the distribution of scores to consider employing nonparametric statistics if necessary.

Third, there are the threats related to issues of interpretation of results. There are six situations, which threaten the interpretation of results. First, is when divergent findings are not resolved, which can be overcome by gathering more data, reanalysing the current data, or evaluating the procedure. Second, when the research questions are not discussed, which can be overcome by addressing each of the questions. Third, when the researcher fails to apply equal weight to each data form, which can be addressed by presenting both sets of results in equal ways or if necessary providing justifications as to why one form of data provides a better understanding of the problem. Fourth, is when interpretation of results is not based in light of the advocacy of social science lens, which can be overcome by the researcher returning in the interpretation of transformative study to the lens used at the beginning of the study and advancing a call for action based on the results. Fifth, is when the stages or projects in a multiphase study are not related to each other, which can be minimised by considering how a problem, a theory, or lens might be an overarching way to connect the stages or phases of project. Finally, is when irreconcilable differences occur among researchers, which can be minimised by having researchers on a team evaluate the overall project objectives, and negotiating philosophical and methodological differences.

Reliability in mixed methods

Reliability is defined as the degree to which the results of a measurement consistently and accurately represent a true magnitude or "quality" of a construct (Teddlie & Tashakkori, 2009). Reliability in mixed methods could be evaluated based on two assumptions (Teddlie & Tashakkori, 2009, p. 211). First, if a measurement is accurate, it should be repeatable. Second, if a measurement has random errors, these errors in representing the true magnitude or quality of the attribute will cancel each other out over repeated measurement. In mixed methods research reliability is discussed in terms of the *quantitative* and *qualitative* strands. Reliability has more to do with the quantitative strands and not so much with the qualitative strands.

There are five ways, proposed by Teddlie and Tashakkori (2009), to determine measurement reliability in mixed methods research (Table 3.5).

Table 3.5. Ways to determine measurement reliability

Reliability	**Evaluation**
Test-retest reliability	Test is reliable if the results of its repeated administration differentiate the members of a group in a consistent manner.
Split-half reliability	Determined by calculating the correlation between two halves of a test. The degree to which the results obtained from the two halves are correlated (consistent) is an indication of the reliability of each of the two half tests.
Parallel forms reliability	Assessed by calculating the correlation between two alternate forms of the same test, administered concurrently to a group of individuals.
Inter-rater (Inter-judge/Inter-observer) reliability	Degree to which the ratings of two or more raters are consistent.

Adapted from: Teddlie and Tashakkori (2009).

3.5 RESEARCH INSTRUMENTS

There are numerous ways to approach securing an answer to a research question or problem therefore it is crucial to approach the problem with appropriate instruments (O'Leary, 2014). With a timeframe of six-weeks to collect data, the researcher had to be strategic in determining the appropriate research instruments. In order to achieve the researcher's objectives, discussion between Paro College of Education lecturers and UNE research supervisor was considered critical as part of the *pre-planning* activity. The discussion with Paro College alongside the research supervisors at UNE resulted in recommending the use of survey, interview, and focus group as the appropriate and realistic instruments. These three types of instruments are discussed in the sections that follow.

3.5.1 Survey instruments

A survey is a method of measuring opinions, views, attitudes, and knowledge by following a structured data collection method in which questions are fixed and possible answers are fixed and limited (Verhoeven, 2011). Another way to look at it is that survey is a system that collects information from informants to describe, compare or explain knowledge, attitudes, and behaviour (Fink, 2003) that enables collection of a significant amount of data from a sizeable population (Gray, 2004). The definition provided by Cohen, Manion, Morrison (2011) is slightly more elaborate and involves describing, comparing, contrasting, classifying, analysing, and interpreting entities and

the events that constitute their various fields of investigation. The following presents discussion on: types of survey, survey protocol and survey analysis.

Types of Survey

All surveys use questionnaires as the instrument but the approach may vary. Four possible types of survey (Verhoeven, 2011) are shown in Table 3.6. Of these four types, online surveys have become more popular in research. There are three main benefits of using an online survey (DePoy & Gitlin, 2011). First, it is inexpensive as questionnaires do not need to be printed out and can be password protected. Second, the reach to audience is wide and data entry can be automated. Third, administration is relatively easy compared to other types of surveys. Responses are received immediately and can be analysed in a short period of time. The survey type considered most suitable for this study was the online survey, to be delivered through a web-based survey tool, because such a survey type is time efficient - noting the six-week data collection window. In addition, there were Internet facilities available at the research site.

Table 3.6. Types of surveys

Survey type	**Approach**
Self-completion (Postal)	The questionnaires are sent through the post for respondents to complete.
Telephone	The survey is conducted by phone and entered straight into the database.
Face-to-face	The interviewer(s) go to the respondents and conduct the interviews and notes the answers. This requires prior appointment to carry out the interviews.
Online	This type of survey is very popular as the data can be collected electronically. For instance, data can be collected using email and through web-based surveys which sends the data straight to the database for analysis.
Panel	Usually carried out using Internet questionnaires where a large group of people is approached to discuss a certain subject. One can get to participate by joining in the discussion where sample is drawn.

Adapted from:Verhoeven (2011)

Survey Protocol

Designing a survey is much more than just the process of designing and collecting data (Gray, 2004). It is important to understand the phases and steps involved in conducting the survey. A five stage process in planning a survey has been identified (Blair, Czaja, & Blair, 2014), as represented in Figure 3.3. These stages were used to guide the survey process in this study.

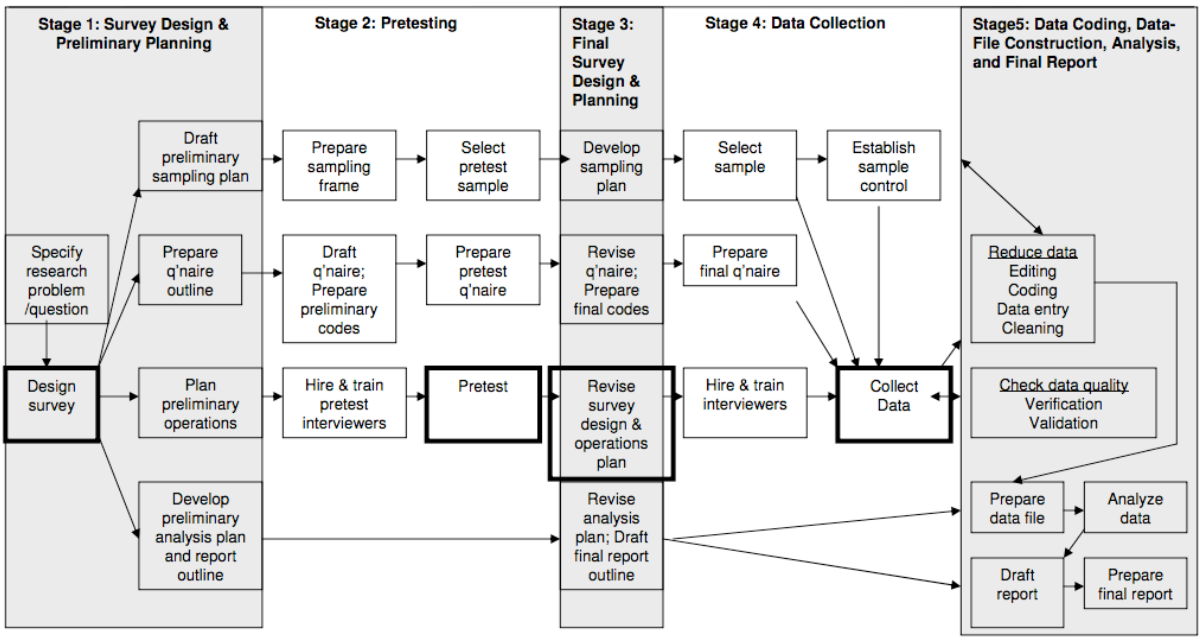


Figure 3.3. Stages of a survey process

Source: Blair et al. (2014)

The first stage, survey design and preliminary planning, begins by making decisions on, identification of target population, type of data to be collected, determining population characteristics, and the nature of data required. During this stage, decisions on the resources and time required are also considered. Making explicit decisions at this stage makes it easier to determine the kind of data analysis that will be required. This stage involves specifying the primary research question that the survey will address and making decisions about how to achieve the objectives of the research and how to achieve it within the given time and resources.

The second stage, pre-testing, involves designing the questionnaire and testing it. The primary activity at this stage is pilot testing the data collection tool. Pilot testing warns the researcher about where the research instrument is likely to fail, whether the protocol can be followed, and whether the proposed method or instruments are appropriate or too complicated (Teijlingen van, Rennie, Hundley, & Graham, 2001). Piloting or pretesting concentrates on three areas: the technical matter (clarity, layout and appearance, timing, length, threat, ease/difficulty, intrusiveness); question part (validity, elimination of ambiguities, and types of questions); and pre-piloting (generating categories, grouping, and classification) (Cohen et al., 2011). Therefore, this stage focuses on the matters relating to coverage and format, and to obtaining feedback on the survey tool.

The third stage, final survey design and planning, is a pretesting stage that informs whether amendments need to be made on elements such as the size of the sampling frame, the questionnaire itself, data coding, and the plans for data analysis.

The fourth stage, data collection, involves selecting the sample, establishing sampling control, and sending explanatory letters. The most important activities during this stage are monitoring responses as well as monitoring the non-response rate. Since non-response has certain implications to the study, it is essential that the researcher checks and takes actions to determine why are there non-responses to the survey.

The final stage is data coding, data-file construction, analysis, and reporting. This stage begins with the coding process where a number is assigned to the responses to each survey question to de-identify data and these are entered into data records. Then, before starting the data analysis, the data needs to be 'cleaned' or checked to avoid any obvious data entry errors.

Survey Analysis

Descriptive statistics can be used to summarise numeric data in easily interpretable tables, graphs, or single representations of group of scores (O'Leary, 2014; Teddlie & Tashakkori, 2009; Trochim, 2006). Descriptive statistics are designed to "measure the characteristics of a particular population, either at a fixed point in time, or comparatively over time" (Gray, 2004, p. 100). In more specific terms, descriptive statistics provide measures of central tendency, dispersion, and distribution shape (O'Leary, 2014). One of the characteristics of descriptive statistics is that they are generally inductive in nature although they are not devoid of theory (Gray, 2004). Good description is crucial in descriptive statistics because good description is the basis of sound theory (De Vaus, 2002) and "unless something is described accurately and thoroughly, it cannot be explained" (Gray, 2004, p. 100). Another important characteristic of descriptive statistics is that they are employed to ascertain attitudes, values, and opinions (Gray, 2004). Descriptive statistics can be used to understand the data, to detect patterns and relationships, and to effectively communicate results (Teddlie & Tashakkori, 2009), but descriptive statistics are not sufficient for drawing inferences and testing hypothesis.

Inferential statistics allow researchers to make generalisations beyond a sample. Inferential statistical methods involve testing hypotheses based on estimations of how much error is involved in obtaining a difference between groups or relationship between variables (Teddlie & Tashakkori, 2009). Some of the frequently use statistical

techniques can be divided into two categories determining whether relationships between variables are truly different from zero or comparing means to test for differences between groups; and testing differences between group means (Teddlie & Tashakkori, 2009, p. 258).

The first category is for determining whether relationships between variables (correlation coefficients or regression slopes) are truly different from zero and includes the use of:

- t-tests: for the significance of Pearson r from zero;
- F-tests: for the significance of multiple correlation; and
- t-tests: for the significance of slopes in multiple regression analysis.

The second category is for testing differences between group means and includes the use of:

- z-tests: to compare the means of a sample with the mean of a population;
- t-tests: to compare the means of two samples (using relevant test for independent and dependent samples);
- Analysis of variance (ANOVA) to compare the means of two or more samples or to compare means in factorial designs (those with more than one independent variable); and
- Analysis of covariance (ANCOVA) to compare the means of two or more samples while controlling for the variation due to an extraneous variable.

In inferential statistics, asking four questions can help the researcher interrogate data at a number of levels (O'Leary, 2014).

- How do participants in my study compare to a larger population?
- Are there differences between two or more groups of respondents?
- Have my respondents changed over time?
- Is there a relationship between two or more variables?

Inferential statistics enable the researcher to assess the probability that an observed difference may occur by chance and thus whether it is statistically significant. The statistical significance is generally referred to as *p-value,* which assesses the actual probability that the findings are more than by chance. The conventional p-values are 0.05, 0.01, or 0.001 and indicate that the probability the findings have occurred by chance is 5/100, 1/100, or 1/1000 respectively (O'Leary, 2014). The lower the p-value,

the more confident the researcher can be that the findings are genuine. A p-value greater than 0.05 is usually not acceptable to the researcher as it is probable that the findings occurred by chance.

There are different software packages available, such as SPSS and SAS, which are capable of running a variety of statistical analyses. As long as the researcher knows which application is appropriate for a particular test, the choice is fairly easy. However, it is crucial that the researcher understands the "nature of the variables (independent/dependent), scales of measurement (nominal, ordinal, interval, ratio), distribution shape (normal or skewed), types of questions you want to ask, and the types of conclusions you are trying to draw" (O'Leary, 2014, p. 287).

There are three types of analysis when dealing with inferential statistics (O'Leary, 2014): Univariate, Bivariate, and Multivariate analysis.

Univariate analysis is where only one variable is tested at a time and the analysis consists of measurement of central tendency, dispersion and distribution, which is mainly descriptive analysis. Although univariate analyses do not look at correlation, cause and effect, or modelling, they are still the essential initial stage in all types and levels of statistical analysis.

Bivariate analysis assesses the relationships between two variables. The most common tests are cross-tabulations (Chi-square, used for two nominal variables), analysis of variance (ANOVA, used for one nominal and one ratio variable), and correlations (used for two ratio variables).

Multivariate analysis explores relationships between three or more variables which enables a level of sophistication that offers the opportunity to explore cause and effect, as well as test theories, and build and test models. Using multivariate analysis the researcher can not only explore whether a dependent variable is dependent on two or more independent variables but also acknowledge the relationship between the dependent variables.

3.5.2 Interview instruments

Interview is one of the commonly employed data collection tools in qualitative research (Creswell, 2007, 2009; Minichiello, Aroni, & Hays, 2008). Interviews are popular because: they allow researchers to consider other people's perspectives as "meaningful, knowable, and able to be made explicit" (Patton, 2002); they are straightforward and non-problematic (Robson, 1993). Unlike questionnaires,

interviews adequately answer *why* questions and provide opportunities to express ideas, feelings, insights, expectations, or attitudes and provide rich information (Opie, 2004). The following presents discussion on: types of interview, interview protocol and interview analysis.

Types of interviews

There are four types of face-to-face interviews: *structured*, *unstructured*, *semi-structured*, and *focus group*. Different types of interviews serve different purposes and each has its own strengths and weakness.

*Structured interview*s involves use of standardised questions that are carefully ordered and worded in advance, each participant is asked the same question(s) and in the same order (Cohen et al., 2011; Minichiello et al., 2008). This type of interview is predominantly used in surveys and opinion polls in a detailed interview schedule (Minichiello et al., 2008) and is useful in three ways (Cohen et al., 2011). First, since the participants the answer same set of questions there is the possibility of increased comparability of responses. Second, in a situation where many interviewers are involved this type of interview helps reduce interviewer effects and biases. Third, the type of data collected in structured interviews facilitates the organization and analysis of data. However, a weakness of this interview type is its rigidity, where the question order and wording cannot be changed making it difficult if the interviewees do not understand the questions.

Unstructured interviews are those that take place in a natural setting where questions are not predetermined and the interview resembles an everyday conversation (Cohen et al., 2011; Minichiello et al., 2008). The question format is open-ended and probing is used to enable participants to elaborate on the topic. The informal and the flexible nature of this type of interview makes data organization and analysis difficult (Cohen et al., 2011).

Semi-structured interviews are those in which issues are identified in advance, an interview guide is provided, and the sequence of questions is decided during the interview. Such interviews are fairly conversational and situational (Cohen et al., 2011; Minichiello et al., 2008). However, the problem with this interview type is that because of its flexibility in sequencing and wording of questions, the chances of yielding different responses are greater (Cohen et al., 2011).

Focus group interviews are a form of group interview where the focus is on the interaction of the group discussing the topic (Cohen et al., 2011). This technique can generate complex information with a minimum investment from a wide range of people (Liamputtong, 2011). One unique feature of a focus group interview is that it works on group dynamics through social interactions (Cohen et al., 2011; Liamputtong, 2011; Minichiello et al., 2008). In a focus group the interviewer takes the role of a facilitator to stimulate discussion (Thomas, 2013).

Selection of the interview types for the study

Focus group interviews were considered a suitable choice for collecting data from pre-service teachers for three main reasons. First, there was a requirement that the opinion of as many pre-service teachers as possible be collected in a short timeframe and this could not have been so easily achieved by other interview types. Second, the participants had certain characteristics in common (for example, level of study) and so could share information more easily in relation to the topic (Krueger & Casey, 2009). Finally, complex information would be able to be gathered in a short data collection timeframe for a minimum investment from wide range of people (Liamputtong, 2011).

Semi-structured interviews were considered suitable for gathering relevant data from the lecturers for four main reasons. First, semi-structured interviews allowed the researcher to explore the participants' perceptions and opinions about complex and sometimes sensitive issues in a conversational style (Minichiello et al., 2008; While, 1994). Second, semi-structured interviews provided flexibility in terms of the order in which the topics are considered and provided respondents with the opportunity to develop ideas and speak more widely on the issues raised by the interviewer (Denscombe, 2010). Third, semi-structured interviews were not restricted to the use of a standardised interview schedule which may not have been suitable for all participants (While, 1994). Finally, they allow the use of seed questions to guide the researcher in staying focused on the relevant issues.

The following elaborates on the instruments, protocol, and analysis for focus group interviews followed by semi-structured interviews - the two chosen qualitative research instruments for this study.

3.5.3 Focus group instruments

Focus group interviews are a "form of group interview, though not in the sense of backwards and forwards between interviewer and group" (Cohen et al., 2011). The

composition of a focus group can be between 5 to 10 people who share certain common traits in a group related to the topic under investigation (Krueger & Casey, 2009). As explained earlier, focus group interviews work on group dynamics through social interactions, allow the researcher to take a facilitation role to facilitate discussions, and can, within a short period of time, generate complex information for a minimum investment.

Although efficient in collecting data from wide range of people and groups compared to individual interviews, there are certain challenges that focus group interview techniques face. Thomas (2013) identified two main criticisms of focus group interviews. First, there is a likelihood that the focus group may not provide sufficient insight into the experiences shared by the respondents. One reason for this is that some of the participants may not take an active part in the discussion leading to insufficient depth of understanding of the participants' experiences. Second, there is a likelihood that some group members will dominate the discussion leading to the collection of information provided mostly by dominant member(s).

3.5.4 Focus group interview protocol

To obtain in-depth information from participants, it is crucial to set a precise plan about how to run a focus group interview. As presented in Table 3.7, the focus group interview is recommended to step through three stages: *Introduction, Questioning,* and *Ending* (Liamputtong, 2011).

Table 3.7. Focus group interview protocol

Stage	**Purpose**
Introduction	Welcomes participants. Introduces aims of the focus group. Sets ground rules.
Questioning	Establishes favourable environment for the focus group. Starts the focus group using the question guide. Uses prompts and probes to create interaction among participants. Facilitates discussion until all questions are covered in sufficient depth.
Ending	Debriefs the participants. Concludes the focus group by summarizing the key points that the participants have provided.

Adapted from: Liamputtong (2011)

Introduction stage involves the interviewer welcoming participants and establishing rapport. The interviewer then informs the participants about the aim of the focus group and the confidentiality of everything said during the focus group interview. This stage ends by the setting ground rules for the focus group, such as: there is no right or wrong answer, disagreement is allowed, and that maximum interaction is welcomed.

Questioning stage involves initiating the focus group discussion by establishing a comfortable environment where participants feel free to speak and interact. Using the question guide prepared beforehand, the researcher begins the interview. Prompts and probes may be used to promote discussion and interaction among the group. The interview continues until all questions are covered adequately. The interview continues until the stage where the data yields no new properties and dimensions within a particular concept leading to a theoretical saturation of the data (Bowen, 2008; Holten, 2007).

Ending stage involves debriefing the participants by asking them whether there is anything they would like to add. The interviewer may conclude by summarising the key points from the discussion and thanking the participants for their time and contribution.

3.5.5 Focus Group Interview Analysis

Qualitative data, such as interview data, can be analysed in one of two ways: deductively where there is a predetermined theory or structure on which the analysis is to be based, or inductively where the analysis is based on the ideas and patterns that emerge from the data (Burnard, Stewart, Treasured, & Chadwick, 2008). In this study the data was planned to be analysed inductively, drawing out themes from the qualitative data. Once qualitative data is collected it can be analysed either manually, or electronically using a software package such as NVivo (Basit, 2003). This makes coding of large amount of interview data more convenient.

Focus group interviews can be analysed using either using *thematic analysis* or by *focus groups and interaction* analysis (Liamputtong, 2011). Thematic analysis looks for themes emerging from the data, whereas focus groups and interaction analysis involves paying attention to interactions that takes in the groups as well as what individuals or the group say about the issue. This study utilised thematic analysis because the

researcher's primary interest was to develop themes emerging from the data. Although group interactions were also important, they were not the focus of this study.

Thematic analysis is one of the most common methods used in analysing qualitative data (Thomas & Harden, 2007) and was the chosen approach for this study. Thematic analysis is a method for identifying, analysing, reporting patterns or themes within data which organises and provides rich description of the data (Braun & Clarke, 2006). Thematic analysis involves searching for repeated patterns of ideas from across a data set achieved by constantly moving back and forth amongst the entire data set. One reason why thematic analysis is so powerful in analysing interview data is that it is applicable to many philosophical stances including essentialist, realist, or constructionist (Braun & Clarke, 2006). Six phases have been proposed by (Braun & Clarke, 2006) for thematic analysis: *Familiarisation with data; Coding; Searching for themes; Reviewing themes; Defining and naming themes; and Writing up* (Table 3.8).

Table 3.8. Six phases of thematic analysis

Phase	**Purpose**
Familiarisation with data	This phase involves transcription, reading and re-reading the data and noting down the initial ideas.
Coding	At this phase codes are generated from data sets to collate data relevant to each code.
Searching for themes	In this phase themes are generated from the collated codes.
Reviewing themes	This phase involves checking themes for coherence to determine whether the codes generated are relevant.
Defining and naming themes	At this stage names are given to the themes are given.
Writing up	Final analysis in relation to the research question and writing the final report.

Source: (Braun & Clarke, 2006)

Within the chosen thematic approach, the core of the inductive analysis is the coding process through which one generates categories from the raw data (Thomas, 2006). In the process of examining the raw data, many words, phrases and ideas repeatedly come up and are organised into codes and categories to determine the meaning from the interview data (O'Connor & Gibson, n.d). Coding is the process of tagging or giving labels to units of meaning using symbols, descriptive words, or naming a category (Johnson & Christensen, 2004). Coding is central to analysis of interview data because "what coding does, above all, is to allow the researcher to communicate with

the data to facilitate the comprehension of the emerging phenomena and to generate theory grounded in the data" (Basit, 2003, p. 152).

3.5.6 Semi-structured Interview Instrument

The choice of semi-structured interviews for collecting data from lecturers was justified, as it is a widely used technique in qualitative research. Semi-structured interviews focus on specific themes in a conversational style where no rigid format is followed (Minichiello et al., 2008). Semi-structured interviews are particularly suited for learning about the motivations behind people's choices and behaviour, their attitudes and beliefs, and the impacts on their lives of specific policies or events (Raworth, Narayan, Sweetman, Rowlands, & Hopkins, 2012). Semi-structured interviews use an interview guide without fixed wording or questions, which enables the researcher flexibility as well as providing for valid explanations of informant perceptions and constructions of reality (Minichiello et al., 2008). Also, as indicated above, semi-structured interviews are flexible in terms of the topic order, provide opportunities to develop ideas and speak more widely, and are suited to explore respondents' perceptions and opinions about complex and sensitive issue.

3.5.7 Semi-structured Interview Protocol

An interview protocol is a plan that outlines the practical procedure and methods for conducting an interview. Interview protocol consists of everything that happens *before*, *during*, and *after* the interview sessions (Bhatnagar, 2009). In order to get the best information from participants, it is important to have a good interview protocol prepared (Jacob & Furgerson, 2012). There are four distinct stages to preparing an interview protocol, as proposed by Anderson (2014): *Building rapport, Seeking information, Exploring statements*, and *Ending respectfully* (Table 3.9).

These four distinct stages are relevant for any interview situation and it is thus applicable for semi-structured interviews. During a semi-structured interview, the researcher uses a set interview guide, which specifically outlines questions based around the issue. This interview guide makes it possible for the researcher to ask questions in the most convenient way without strictly adhering to the order of questions, as is the case with a structured interview. This interview guide is more flexible, giving the researcher the opportunity to probe and prompt for more information.

Table 3.9. Semi-structured interview protocol

Stage	**Purpose**
Building rapport	To establish foundation for the interview process by: • Orienting the participants • Learning about the participants • Facilitating the participant's best possible functioning
Seeking information	To allow participants to report their experiences
Explore statements	To allow participants to share details about their experiences
End respectfully	Provide respectful closure to and transition from the interview by attending to the participant's: • Presentation • Communicated experience • Observed needs

Adapted from: (Anderson, 2014)

3.5.8 Semi-structured Interview Analysis

There are different approaches to analysing interview data including: grounded theory, discourse analysis, content analysis, narrative analysis, conversation analysis, semiotics, hermeneutics (O'Leary, 2014), and thematic analysis (Braun & Clarke, 2006). The study made use of thematic analysis because as for the focus group interviews, the researcher's primary interest was to develop themes emerging from the data. The procedure for conducting thematic analysis was discussed in Scection 3.5.5.

3.6 CHAPTER CONCLUSION

This chapter presented the interplay between the research setting and the process of selecting a suitable research approach to address the research questions in Chapter One At the time of the research, Paro College of Education trained primary and secondary pre-service teachers and was one of the nine member colleges the Royal University of Bhutan, the only university in Bhutan. At the college all pre-service teachers studied at least one ICT module and all BEd Secondary pre-service teachers had to major in teaching ICT and one other subject.

The researcher's pragmatic philosophical view led to the selection of a mixed method approach for the study. This methodology allowed the collection of both quantitative and qualitative data, which assisted in triangulating results to enhance reliability and validity, especially to overcome biases that might result from using only quantitative or qualitative data. The mixed methods research design chosen for the studywas convergent parallel design. Convergent parallel design was chosen because it allowed

the researcher to compare and contrast results from different data sources and then merge them for interpretation.

Various measures were planned to address the validity and reliability in this study. Threats to validity were to be addressed at: the collection phase by collecting both quantitative and qualitative data; the analysis phase by displaying appropriate statistical results as well as using themes with relevant quotes from the data; and at the interpretation phase by giving equal weight to the results of both strands of data by keeping in mind the research questions. Reliability was to be measured through relevant statistical tests in the quantitative analyses, and through coder agreement processes in the qualitative analysis.

Both quantitative (surveys) and qualitative (semi-structured interviews and focus group interviews) research instruments were chosen for the study. Web-based surveys were considered the most appropriate type of survey in order to maximise the number of lecturers and pre-service teachers responding. Focus group interviews with pre-service teachers were chosen to enable the flexible collection of data from the greatest number of participants in a short timeframe. Semi-structured interviews with lecturers were chosen to allow the use of seed questions and offer flexibility in the order in which questions are asked.

Relevant techniques were chosen to analyse the quantitative data and the qualitative data. The web-based survey data analysis was planned to involve the use of descriptive statistics and inferential statistics (t-test and ANOVA). For analysis of the data from the focus group interviews and semi-structured interviews a thematic analysis approach was planned.

Having made planning decisions for the research methodology, detailed planning was needed for the actual research design. This planning is described in detail in the next chapter.

CHAPTER FOUR

RESEARCH PLAN

This chapter presents the research plan for the study, including the development of the four data collection instruments: web-based pre-service teacher survey; web-based lecturer survey; pre-service teacher focus groups; and lecturer semi-structured interviews. For the sake of clarity, the instruments while designed concurrently are described separately. The chapter comprises twelve sections. The first section provides an overview of the research. The second section presents the ethical considerations. The third section describes participant recruitment. The fourth section presents the web-based survey instrument development. The fifth section describes how the web-based surveys were to be administered. The sixth section presents the plan for analysis of the web-based survey data. The seventh section describes the focus group interview instrument and semi-structured interview instrument development. The eighth section describes how the focus group interview instrument was to be administered. The ninth section describes how the semi-structured interview instrument was to be administered. The tenth section describes the plan for the analysis of qualitative data. The eleventh section presents research schedule. The twelfth section provides a conclusion to the chapter.

4.1 RESEARCH OVERVIEW

In the study, the following research questions were addressed.

1. What are pre-service teacher and lecturer attitudes towards GNH?
2. What are pre-service teacher and lecturer attitudes towards ICT use?
3. What are the enablers of the use of ICT to enhance GNH in education in pre-service teacher education?
4. What are the inhibitors of the use of ICT to enhance GNH in education in pre-service teacher education?

As described in Chapter Three, the agreed research instruments to address these four research questions were a web-based survey of pre-service teachers, a web-based survey of lecturers, focus group interviews with pre-service teachers and semi-structured interviews with lecturers. The timeframe for the data collection was

constrained to a six-week window that was available to the researcher allowing for data collection early in the semester, at a time preferred by lecturers and considered to be least disruptive for the pre-service teachers.

4.1.1 Preliminary design parameters

Due to the study context, three factors were identified that needed to be taken into account for the preliminary design of the research instruments. These were, addressing cultural protocols, English as a second language, and power relationships.

Addressing cultural protocols

Asking lecturers directly about knowledge and attitudes of GNH in the web-based survey was considered inappropriate lest they construe this as being tested on how much they know about GNH. There was the concern that this could lead to potential discomfort for the lecturer participants who as a result, might be less than forthcoming in their responses. Accordingly, it was decided that in the web-based survey, lecturers would be asked for their perceptions of their pre-service teachers' knowledge of GNH. Such an approach was considered suitable as it allowed the researcher to identify any potential misalignment between pre-service teachers' perceptions of themselves and lecturers' perceptions of pre-service teachers for a range of web-based survey items. Data pertaining to lecturers' knowledge and attitudes of GNH were instead asked in the semi-structured interviews where rapport could be developed and lecturers put at ease that they were not being tested rather their views were simply being sought

English as a second language

During the design of the research instruments, three actions were necessary to avoid ambiguities due to the manner in which English was used by the Bhutanese participants, for whom English was a second language. First, it was decided that no reverse coded questions were to be used in the pre-service teacher and lecturer web-based surveys. The concern was the participants may not read the reverse coded questions carefully, leading to a potential increased level of errors. Second, the style of English used in the survey questions was designed to suit the Bhutanese way of speaking. Finally, for the interviews it was decided that the participants were to be encouraged to use Dzongkha, as well as English, if required in order to fully express themselves.

Power relationships

Two types of power relationships were considered important in designing the protocols and delivery of the qualitative research instruments. The first type of power

relationship was between the researcher, who was at a more senior level, and the potential lecturer interviewees. A mechanism for dealing with this power relationship was factored into the lecturer interview protocol by including an invitation rather than a request to be interviewed, and stressing the voluntary nature of participation in the research. This was designed to encourage only those lecturers who felt comfortable with being interviewed to elect to take part. The second type of power relationship was between the lecturers and the pre-service teachers who they taught. It was initially considered having the interviews conducted by college lecturers. However, due to the power relationship that lecturers had over the pre-service teachers, the decision was made that the researcher, who was not lecturing at the college at the time, would lead the focus group interviews. This decision was made to encourage the pre-service teachers to be more comfortable in sharing honest opinions when interviewed.

4.1.2 Mapping the data collection instruments against the research questions

The following explains how the different data collection instruments were mapped towards addressing each research question.

RQ1: What are pre-service teacher and lecturer attitudes towards GNH?

The pre-service teacher component of this research question was mapped against the two web-based surveys and the focus group interviews. The lecturer component of this research question was mapped against the semi-structured interviews.

RQ 2: What are pre-service teacher and lecturer attitudes towards ICT use?

The pre-service teacher component of this research question was mapped against the two web-based surveys and the focus groups interviews. The lecturer component was mapped against the semi-structured interviews. Pre-service teachers and lecturers were asked questions through the lens of the two theoretical frameworks (SAMR and TPACK) used in this study.

RQ 3: What are the enablers of the use of ICT to enhance GNH in education in pre-service teacher education?

This research question was mapped against semi-structured interviews for lecturers and focus group interviews with pre-service teachers to identify potential enablers. The survey items were mapped against those areas that are likely to make use of ICT to enhance GNH principles and values. The items were focused through the SAMR and TPACK lenses to determine conditions required for the successful use of ICT to enhance GNH.

RQ 4: What are the inhibitors of the use of ICT to enhance GNH in education in pre-service teacher education?

Focus groups interviews with pre-service teachers and semi-structured interviews for lecturers were employed to identify potential barriers. Personal perceptions of ICT for both pre-service teachers and lecturers were sought to identify potential barriers to using ICT to enhance GNH principles and values. The survey items were viewed through the SAMR and TPACK lens to determine factors that impede the use of ICT to enhance GNH principles and values.

A data triangulation matrix was prepared to assist in identifying the types of data required to answer each research question, the sources from which the data would be obtained for each research question, and how the different data sets would be analysed. The overall plan is presented in Table 4.1.

Table 4.1. Data triangulation matrix

Research Question	**Participants**	**Data Type**	**Data source**	**Data analysis**
RQ1: What are pre-service teacher and lecturer attitudes towards GNH?	Pre-service teachers	Quantitative	Survey	Descriptive
		Qualitative	Focus group interviews	Inferential Thematic
	Lecturers	Qualitative	Semi-structured interviews	Thematic
RQ2: What are pre-service teacher and lecturer attitudes towards ICT use?	Pre-service teachers	Quantitative	Survey	Descriptive
		Qualitative	Focus group interviews	Inferential Thematic
	Lecturers	Qualitative	Semi-structured interviews	Thematic
RQ3: What are the enablers of the use of ICT to enhance GNH in education in pre-service teacher education?	Pre-service teachers	Quantitative	Survey	Descriptive
		Qualitative	Focus group interviews	Inferential Thematic
	Lecturers	Quantitative	Survey	Descriptive
		Qualitative	Semi-structured interviews	Inferential Thematic
RQ4: What are the inhibitors of the use of ICT to enhance GNH in education in pre-service teacher education?	Pre-service teachers	Quantitative	Survey	Descriptive
		Qualitative	Focus group interviews	Inferential Thematic
	Lecturers	Quantitative	Survey	Descriptive
		Qualitative	Semi-structured interviews	Inferential Thematic

4.2 ETHICS

For this study two ethics approvals were sought before the researcher was able to begin the data collection. Approval was obtained from the University of New England

Ethics Committee, because the research involved postgraduate study at the university. Approval was obtained from Paro College of Education, as the study participants comprised pre-service teachers and lecturers at the college. See Appendix 1 for the details of the University of New England (UNE) ethics approval. and Appendix 2 for the Paro College of Edication (PCE) ethics approval. All participants were informed that participation in the study was voluntary. An academic member of staff at the research site was nominated to be the contact person in the event of problems arising in the manner in which the research was conducted.

4.3 PARTICIPANT RECRUITMENT

The target populations for the study were all pre-service teachers enrolled in the BEd (Primary), BEd (Secondary) and BEd (Dzongkha) and their lecturers at Paro College of Education. Following ethics approval, an invitation to participate in the research by completing a web-based survey was extended to all pre-service teachers by placing an announcement in the Paro College of Education's official Moodle site, where all official learning-related announcements were placed. The lecturers were to be invited by email to participate in the research. The invitations made it clear that participation was voluntary. Implied consent to participate in the surveys was assumed to be given once the completed web-based survey had been submitted.

An invitation to participate in the pre-service teacher focus group interviews was to be extended at the end of the pre-service teacher survey. An invitation to participate in the lecturer semi-structured interviews was to be extended at the end of the lecturer survey. Both pre-service teachers and lecturers were to be asked to respond by providing their email addresses so that they could be contacted for the interviews.

Fifteen focus group (four to six per group) interviews were planned for pre-service teachers, with equal male and female representation. Ten semi-structured interviews comprising five males and five females were planned for lecturers. All potential interviewees were informed that participation was voluntary and that anonymity of participation was assured. The name of a contact person was provided in the event that the participant felt that treatment had been unfair during the data collection. Finally, the consent form was to be signed before each interview began.

4.4 SURVEY INSTRUMENT DEVELOPMENT

The success of a survey depends on the researcher applying an adequate amount of thought to the planning process including consideration of *who, where, when, how, and*

what (O'Leary, 2014). The survey instrument development for this study was based on the five stage process proposed by Blair, Czaja, and Blair (2014), see Figure 3.3 (Chapter 3). The five development stages were: *Survey design and preliminary planning*; *Pretesting*; *Final survey design and planning; Data collection;* and *Data coding, data-file construction, analysis and final report*. Two separate web-based surveys were designed for data collection: Pre-service Teacher Survey (Appendix 3) and Lecturer Survey (Appendix 4). The lecturer web-based survey comprised some items from the pre-service teacher survey plus items where the lecturers were asked to provide their perceptions of the pre-service teachers. The following presents how those five stages of development were followed in the design of the web-based surveys for the study.

4.4.1 Stage 1: Survey design and preliminary planning

The web-based surveys comprised 53 items for pre-service teachers and 54 items for lecturers. It is acknowledged that due to time constraints on participants completing the web-based surveys only multiple-choice items were to be used and no open-ended items. In order to successfully answer the research questions, both the pre-service teacher and lecturer web-based surveys focused on four aspects, *GNH and GNH in education*, *ICT in education*, *ICT enhancing GNH principles and values, and TPACK*. These areas were explored by reviewing the research literature with the view of utilising items from existing surveys. The selected survey items were drawn from different sources, and then either adapted or used as they appeared in existing surveys. Specifically, the GNH and GNH in education aspect items were designed using information from *Educating for Gross National Happiness: Refining our school education practices* (Ministry of Education, 2011). The ICT in education aspect items were derived from existing surveys (Al-Zaidiyeen, Mei, & Fook, 2010; Almekhlafi & Almeqdadi, 2010; Plomp, Pelgrum, & Law, 2007; Presridge, 2012). The ICT enhancing GNH aspect items were derived from sources acknowledged in the previous two aspects. The TPACK items were derived from Schmidt, Thompson, Mishra, Koehler, and Shin (2009). Four areas of TPACK (TK, TCK, TPK, and TPACK) were selected as the most relevant to elicit the required information to answer the research questions.

The same set of web-based survey items was prepared for both pre-service teachers and lecturers, except that the survey for the lecturers was designed to obtain their perspectives of relevant aspects in relation to their pre-service teachers, rather than their own attitudes. This was achieved by adding the question stem, 'I am confident

my students…' followed by the survey item. The following presents the survey items selected for each of the four aspects and justifies the selection of these items.

GNH and GNH in education

Three items were selected to provide information for the *GNH and GNH in education* aspect. These are presented in Table 4.2, as worded for the lecturer survey. These items were designed to elicit lecturer perceptions of the pre-service teacher attitudes towards GNH. Table 4.2 shows the selected items, the rationale for the inclusion of each item, and the particular research question(s) addressed. For the pre-service teacher survey the items were expressed differently so as to elicit pre-service teachers' own attitudes to GNH. For example, the first item in the pre-service teacher survey began 'I believe I possess…', rather than 'I am confident my students possess…'.

Table 4.2. Item selection for the GNH aspect

Survey item	**Reason(s) to include**	**Addressing**
I am confident my students possess adequate knowledge about GNH principles and values.	Attitudes towards GNH	RQ1
I am confident my students believe GNH should be infused into my day-to-day teaching.	Attitudes towards GNH	RQ1
I am confident my students believe it is necessary for the pre-service teacher curriculum in Bhutan to reflect GNH.	Attitudes towards GNH	RQ1

ICT in education

Ten items were selected to provide information for the *ICT in Education* aspect. These are presented in Table 4.3, as worded for the lecturer survey. These items were designed to elicit lecturer perceptions of the pre-service teacher attitudes towards ICT. Table 4.3 shows the selected items, the rationale for the inclusion of each item, and the particular research question(s) addressed. As was the case with the GNH aspect, for the pre-service teacher survey the items were expressed differently so as to elicit pre-service teachers' own attitudes to ICT. For example, the first item in the pre-service teacher survey began 'I believe ICT tools can …', rather than 'I am confident my students believe ICT tools can …'.

Table 4.3 Item selection for the ICT aspect

Survey item	**Reason(s) to include**	**Addressing**
I am confident my students believe ICT tools can make my teaching and learning more effective	Attitudes	RQ2
I am confident my students believe the use of ICT tools make learning activities more efficient	Attitudes	RQ2

Survey item	Reason(s) to include	Addressing
I am confident my students believe ICT enhances the way they learn	Attitudes	RQ2
I am confident my students believe ICT is an effective tool to create conducive learning environments for learners	Attitudes	RQ2
I am confident my students believe ICT is a good tool to engage students	Attitudes	RQ2
I am confident my students believe ICT can make learning more efficient	Attitudes	RQ2
I am confident my students believe ICT can improve the quality of education	Attitudes	RQ2
I am confident my students believe ICT can improve the academic performance of learners	Attitudes	RQ2
I am confident my students believe using ICT has the potential to improve one's ability to teach	Attitudes	RQ2
I am confident my students believe it is possible to change learning from passive to active using ICT tools	Attitudes	RQ2

ICT enhancing GNH principles and values

Seventeen items were selected to provide information for the *ICT enhancing GNH principles and values* aspect. These are presented in Table 4.4, as worded for the lecturer survey. These items were designed to elicit lecturer perceptions of the pre-service teacher attitudes towards ICT enhancing GNH principles and values. Table 4.4 shows the selected items, the rationale for inclusion of each item, and the particular research question(s) addressed. As was the case with the GNH and ICT aspects, for the pre-service teacher survey the items were expressed differently so as to elicit pre-service teachers' own attitudes to ICT enhancing GNH. For example, the first item in the pre-service teacher survey began 'I believe ICT has the potential …', rather than 'I am confident my students believe ICT has the potential …'.

Table 4.4. Item selection for the ICT enhancing GNH aspect

Survey item	Reason(s) to include	Addressing
I am confident my students believe ICT has the potential to make them more imaginative students	Attitudes	RQ1 & RQ2
I am confident my students believe ICT tools can help enhance creativity	Attitudes	RQ1 & RQ2
I am confident my students believe ICT tools have the potential to effectively internalise GNH values	Attitudes	RQ1 & RQ2
I am confident my students believe ICT can be an effective tool to foster GNH to better become part of their lives	Attitudes	RQ1 & RQ2
I am confident my students believe ICT tools can make learning more enjoyable	Attitudes	RQ1 & RQ2
I am confident my students believe ICT tools can make learning more relevant	Attitudes	RQ1 & RQ2
I am confident my students believe GNH values are enhanced more efficiently using ICT tools	Attitudes	RQ1 & RQ2

Survey item	Reason(s) to include	Addressing
I am confident my students believe ICT is an efficient tool to enhance GNH values such as integrity	Attitudes	RQ1 & RQ2
I am confident my students believe ICT is an efficient tool to enhance their motivation to learn	Attitudes	RQ1 & RQ2
I am confident my students believe the use of ICT tools aid in enhancing critical thinking skills	Attitudes	RQ1 & RQ2
I am confident my students believe that using ICT tools enhance student ability to collaborate efficiently	Attitudes	RQ1 & RQ2
I am confident my students believe ICT tools possess the potential to make learners become more reflective	Attitudes	RQ1 & RQ2
I am confident my students believe ICT is a good tool to help one become more mindful about what one does	Attitudes	RQ1 & RQ2
I am confident my students believe ICT is an effective tool to learn about media literacy	Attitudes	RQ1 & RQ2
I am confident my students believe ICT has the potential to create life-long learners	Attitudes	RQ1 & RQ2
I am confident my students believe using ICT tools can improve a student's emotional well-being	Attitudes	RQ1 & RQ2
I am confident my students believe using ICT can empower a learner	Attitudes	RQ1 & RQ2

Technological Knowledge (TK)

Six items were selected to collect information about pre-service teacher and lecturer Technological Knowledge (TK). These six items were the same for both pre-service teachers and lecturers. Table 4.5 shows the selected items, the rationale for including each item, and the particular research question(s) addressed by each item.

Table 4.5. Item selection for the TK aspect

Survey item	Reason(s) to include	Addressing
I know how to solve my own technical problems	Knowledge of TK	RQ3 & RQ4
I learn technology easily	Knowledge of TK	RQ3 & RQ4
I keep up with new technologies	Knowledge of TK	RQ3 & RQ4
I frequently play around with the technology	Knowledge of TK	RQ3 & RQ4
I know a lot about different technologies	Knowledge of TK	RQ3 & RQ4
I have the technical skills needed to use technology	Knowledge of TK	RQ3 & RQ4

Technological Pedagogical Knowledge (TPK)

Five items were selected to collect information about pre-service teacher and lecturer Technological Pedagogical Knowledge (TPK). As with TK, these items were the same for both pre-service teachers and lecturers. Table 4.6 shows the selected items, the rationale, for including each item, and the particular research question (s) addressed by each item.

Table 4.6. Item selection for the TPK aspect

Survey item	Reason(s) to include	Addressing
I know how to choose technologies that enhance students' learning for a lesson	Knowledge of TPK	RQ3 & RQ4
I know how choose appropriate technologies to enhance teaching approaches for a lesson	Knowledge of TPK	RQ3 & RQ4
I can think critically about how to use technology in the classroom	Knowledge of TPK	RQ3 & RQ4
I am confident to customise the technology that I own to different teaching activities	Knowledge of TPK	RQ3 & RQ4
I am able to select appropriate technologies to use in my classroom to enhance what I teach	Knowledge of TPK	RQ3 & RQ4

Technological Content Knowledge (TCK)

Three items were selected to collect information about pre-service teacher and lecturer Technological Content Knowledge (TCK). As with TK and TPK, these items were the same for both pre-service teachers and lecturers. Table 4.7 shows the selected items, the rationale, for including each item, and the particular research question(s) addressed by each item.

Table 4.7. Item selection for the TCK aspect

Survey item	Reason(s) to include	Addressing
I know how to choose technologies that enhance the development of GNH values in my lessons	Knowledge of TCK	RQ3 & RQ4
I know how to choose technologies that can enhance the content for a lesson	Knowledge of TCK	RQ3 & RQ4
I know how to select ICT that enhances what I teach	Knowledge of TCK	RQ3 & RQ4

Technological Pedagogical and Content Knowledge (TPACK)

Four items were selected to collect information about pre-service teacher and lecturer Technological Pedagogical and Content Knowledge (TPACK). Again, the same items were same for both pre-service teachers and lecturers. Table 4.8 shows the selected items, the rationale, for including each item, and the particular research question(s) addressed by each item.

Table 4.8. Item selection for the TPACK aspect

Survey item	Reason(s) to include	Addressing
I know how to use strategies that combine content, technologies and teaching approaches	Knowledge of TPACK	RQ3 & RQ4
I possess adequate skills to provide leadership in helping others	Knowledge of TPACK	RQ3 & RQ4
I am able to use strategies that combine content, ICT, and teaching approaches	Knowledge of TPACK	RQ3 & RQ4
I can appropriately combine content, ICT, and teaching approaches in a classroom lesson	Knowledge of TPACK	RQ3 & RQ4

4.4.2 Survey design considerations

Two design considerations needed to be taken into account during the survey development. These were language and cultural constraints, and question selection and ordering.

Language and cultural constraints

The survey was planned to be prepared in English. As identified previously, careful considerations were given to planning to overcome the challenges of using English for participants who had English as a second language. When designing the web-based survey, the researcher considered it important to be careful about the kind of language used in the survey because it had to be done with sentences/phrases that were commonly used. For instance, the research team made sure that questions used were culturally appropriate (Green & Thorogood, 2011). These considerations of being culturally sensitive in the language used was considered important because culturally inappropriate language can lead to respondents not understanding the question or wrongly construing the question resulting in responses not related to the actual question (Lee, 2006). Web-based survey items were written in simple language to aid in producing a higher response rate (Lee, 2006). As mentioned, another precaution was to not use reverse wording in the web-based survey items to help prevent confusion in responding (Van Sonderen, Sanderman, & Coyne, 2013).

Question selection and ordering

Selection and ordering of survey items were considered important because having appropriate items in a suitable sequence impacts how participants interpret or respond. In particular, the order of the response categories can also influence the actual responses (Nardi, 2003). Such precautions help in minimizing biases.

As it is acceptable, even an encouraged norm, to borrow survey items from other research studies (Blair et al., 2014), the researcher, in consultation with the supervisory team, decided to borrow most of the items related to confidence in ICT and TPACK from previously administered surveys.

Web-based survey items were sorted into a logical sequence, particularly to make it more convenient for the respondents. The web-based survey was grouped into three parts: A, B and C. For pre-service teachers, Part A. demographic information, comprised sex, age, enrolment, area of specialization, year of study, and teaching practice experience. For lecturers, Part A. demographic information comprised, sex, age, specialization, teaching experiences, and subjects currently taught. For both pre-service teachers and lectures, Part B comprised the items from the three aspects: GNH and GNH in education; ICT in education; and ICT enhancing GNH. Part C comprised items related to personal perceptions of ICT. The rationale for using these three parts in the survey was to help overcome confusion when participants completed the survey. Part B required pre-service teachers to give their perceptions of themselves but required lecturers to provide their perceptions of pre-service teachers. The TPACK items were grouped together in Part C, rather than being included in Part B, so that lecturers did not confuse the items with items in Part B. In Part C, instead of using the language of TPACK, more generic terms were used to elicit personal perceptions of ICT. This was to reduce misunderstanding due to respondents not being fully aware of the TPACK terminology.

4.4.3 Stage 2: Pretesting

To determine the suitability of the web-based survey, it had to be piloted with people who resembled the actual participants. The plan was to negotiate with academics at Paro College of Education to participate and help the researcher to arrange two pre-service teacher volunteers and two lecturer volunteers for the pilot test.

Once the participants for the pilot had been identified an email was sent to indicate the URL link to the site where the survey was located. Pilot participants were asked to provide feedback on four areas (Mitchell & Jolly, 1996).

- The clarity of the Participant Information Sheet: Was the information provided clear, concise and unambiguous?
- The clarity of survey items: Were these clear, concise, and unambiguous?
- The amount of time and effort it took to complete the survey.

- Anything else that was felt to be worthy of mention.

4.4.4 Stage 3: Final survey design and planning

Based on the feedback from the pilot participants, necessary amendments were to the survey instrument. Two types of changes had to be made to the language in the survey to better suit the Bhutanese participants. First, the sentence structure in some items had to be changed. For example, *I am confident to use strategies that combine content, ICT and teaching approaches.* Second, the term technology that had been used in some of the items to suit the local context was replaced by ICT because the actual participants were familiar enough with the term. The final version of the pre-service teacher web-based survey instrument is presented in Appendix 3 and the final version of the lecturer web-based survey is presented in Appendix 4.

The next two sections explain how the pre-service teacher survey and the lecturer survey were administered and analysed.

4.5 ADMINISTRATION OF WEB-BASED SURVEY INSTRUMENTS

Both the pre-service teacher web-based survey and the lecturer web-based survey were built using the online survey tool, *Qualtrics*, because it provided all necessary features and the university supporting the research had a licence for this software. Both surveys were designed to run concurrently using the Paro College of Education's Virtual Learning Environment (VLE), Moodle. This VLE was chosen because all the pre-service teachers and lecturers were familiar with using this platform and, more importantly, this VLE was commonly used to make all the official announcements at the college. A link to the web-based survey was provided at the end of the invitation shared via the VLE.

4.6 ANALYSIS OF SURVEY DATA

Both the pre-service teacher and the lecturer surveys were analysed following the same statistical analysis procedure. The data was analysed using statistical software, SPSS. Both descriptive and inferential analyses were undertaken.

4.6.1 Descriptive analysis

The first part of the statistical analysis comprised descriptive analysis. The descriptive analysis was planned to present the measure of demographic profiles of respondents, their behaviours and attitudes, and perceptions towards GNH and ICT. The frequency

analysis with Likert scale results were presented with frequencies and percentages, and summarised using means and standard deviations.

4.6.2 Inferential analysis

The second part of the statistical analysis comprised inferential analysis including both t-tests and ANOVA. T-tests for the independent variable sex were used for comparison between the responses of males and females T-tests were used to compare pre-service teacher and lecturer responses to the respective survey items. ANOVA was used to identify statistically significant differences for the pre-service teacher independent variables: age, sex, and enrolment programme. ANOVA was used to identify statistically significant differences for the lecturer independent variables: age, sex, and teaching experience.

4.7 FOCUS GROUP INTERVIEW AND SEMI-STRUCTURED INTERVIEW INSTRUMENT DEVELOPMENT

The following presents the various steps and procedures utilised in developing the pre-service teacher focus group interview and lecturer semi-structured interview instruments.

4.7.1 Question development

Pre-service teacher focus group interview and lecturer semi-structured interview question development procedures followed a similar pattern. In developing the questions there were three important considerations, exploring key aspects, revisiting language and cultural constraints, and pilot.

Exploring key aspects

As stated in Chapter Three, the researcher had a six-week window to collect data to explore key aspects to effectively address the research questions. Three keys aspects, GNH, ICT, and TPACK were to be explored through the interviews. The research team met and explored the advantages and disadvantages of exploring each of these aspects. The research team debated an initially proposed list of aspects, refined the list, and finally agreed upon those aspects to be included to inform the data already collected in the survey. Table 4.9 provides a summary of that discussion and includes the research questions being addressed.

Table 4.9. Summary of discussion of key aspects

Aspect	Advantages of exploring	Disadvantages of exploring	Addressing
GNH	Confidence Attitude Beliefs	Cannot determine attitude to GNH Incomplete picture	RQ1, RQ3, RQ4
ICT	Confidence Beliefs ICT skills Attitude to ICT Determine skill level Determine current practice	Not know perspectives Not know attitude Not know enablers Not know current practice Limited perceptions	RQ1, RQ2, RQ3, RQ4
TPACK	Perception of TPACK	Current practice not known Not know what they know about TPACK	RQ3, RQ4

Revisiting language and cultural constraints

The way language is used can impact the willingness of the participants to actively participate and provide meaningful information. Since the interviews were to be conducted in English, the researcher had to be mindful of the way the interview questions were structured, as well as the way the questions were delivered. Care with both question structure, and the delivery mode needs to be taken seriously because if not, then either the question may be construed differently or someone may be put in an embarrassing situation (Kim & Mattila, 2011). The decision was made to make the seed question format simple by not asking pressure questions that may put participants in a difficult situation. For example, asking questions that might appear to be testing lecturers' knowledge of GNH should be approached cautiously to avoid lecturers' misunderstanding the questions intent.

Generation of pilot questions

The research team each proposed potential interview questions based on the three aspects in Table 4.9. These were debated in terms of suitability to prepare a set of questions for the pilot test. A suitable question order was decided following the instructions outlined in Chapter 3. The pre-service teacher focus group interview comprised eight seed questions and lecturer interview comprised nine seed questions.

Pilot testing

The purpose of the pilot test was two-fold: to enhance the researcher's interview skills and to clarify the interview questions. Selection of pilot participants was carried out so that ethnically and age-wise the group resembled the actual participants. The pre-service teacher focus group interview was piloted with five undergraduate Bhutanese

students at UNE, and the lecturer semi-structured interview was piloted with two lecturers from the actual research site who, at the time, were studying at UNE.

Each interview was recorded and the researcher listened for clarity, and to understand whether the questions were confronting for the participants. Later, the pilot participants were asked for their feedback to refine the seed questions.

4.7.2 Refining the Seed Questions

The feedback provided by the pilot participants was analysed to decide whether to make any changes to the original seed questions. Following the analysis, no changes were made to the pre-service teacher focus group interview seed questions. The undergraduate Bhutanese students who participated in the pilot focus group interview had some problems with understanding the terms GNH principles and ICT. However, the GNH-related and the ICT-related questions were not changed because the pre-service teachers at the research site who were to participate in the main focus group interviews were known to be familiar with the terms GNH and ICT. Similarly, no changes were made to the lecturer semi-structured interview seed questions. One lecturer participating in the pilot had difficulty in responding to the question about how ICT might be used to enhance GNH principles and values, but this was not considered to be due to a lack of understanding of the actual terms.

4.7.3 Final Instruments

The final set of seed questions for the pre-service teacher focus group interviews are presented in Figure 4.1.

What is something you have done or seen using ICT in teaching that has worked really well? (Prompt-may be at college or on teaching experience)
How do you think the things you like doing with ICT could be integrated into the teaching and learning at college?
What aspect of using ICT at college do you like?
So how do you think ICT could be used for educating for GNH?
What types of things do you think could be done to better help support you in the use of ICT in educating for GNH?
So what might be stopping you or your friends in the use of ICT in educating for GNH?
What is something maybe at college or teaching experience you have done or seen, that you believe has used ICT for educating for GNH really well?
Is there anything you might like to add further?

Figure 4.1. Pre-service teacher focus group interview seed questions

The final set of seed questions for the lecturer semi-structured interviews are presented in Figure 4.2.

What aspect of ICT do you think students really like?
What is something you have done or seen using ICT in teaching that has worked really well?
How do you think the things students like doing with ICT could be integrated into your teaching?
Comparing ICT base tools to traditional tools, what do you think are the advantages and disadvantages?
How do you see/envisage ICT could be used for educating for GNH?
What are the barriers you see might be stopping the use of ICT in educating for GNH?
So what might be done to help support the use of ICT in educating for GNH?
What is something you have done or seen that used ICT in educating for GNH really well?
Is there anything you might like to add further?

Figure 4.2. Lecturer semi-structured interview seed questions

4.8 ADMINISTRATION OF PRE-SERVICE TEACHER FOCUS GROUP INTERVIEW INSTRUMENT

The research team, after negotiating with the academics, agreed to administer fifteen focus group interviews. The plan was for each focus group to consist of six members, with at least three focus groups from each year of study. Ideally, there were to be equal numbers of male and female pre-service teachers across the fifteen groups. Focus groups were to take place in one of the tutorial rooms in the faculty building of the college.

Pre-service teacher focus group were to be carried out following three steps (Liamputtong, 2011) as described in Chapter Three. To reiterate, the first step, *Introduction*, involved welcoming participants, briefing on the aims of the focus group, and setting ground rules for the interviews. The second step, *Questioning*, included creating favourable conditions/building rapport, starting focus group interviews following the interview guide, use probing question, and facilitating focus group discussion until all the questions (see, Figure 4.1) were covered in depth. The third step, *Ending*, involved debriefing pre-service teacher participants by asking them if there are any more points they wanted to add. The focus group interview was planned to end by summarising the key points raised in the focus group interview.

4.9 ADMINISTRATION OF LECTURER SEMI-STRUCTURED INTERVIEW INSTRUMENT

As mentioned previously, the choice of semi-structured interviews for lecturers was decided in consultation with academics at the college. The data was planned to be collected by interviewing ten lecturers from different subject backgrounds and different teaching experiences, with an equal number of males and females.

Semi-structured interviews were to be carried out following four-step interview protocol (Anderson, 2014): *Building rapport*, *Seeking information*, *Exploring statements*, and *Ending respectfully*. The first step, *Building rapport* was to create a rapport and a comfortable environment in which participants would be able to express themselves without any hesitation. Attention was paid to the language that is suitable to the Bhutanese culture to obtain optimum information. The second step, *Seeking information* was to seek lecturers' perceptions and experiences using the interview guide (Figure 4.2). The interview was planned to begin with easier questions first to make the participants more relaxed to elicit as much information as possible. Wherever necessary probing and prompting were to be used. The third step, *Exploring statements*, was where participants were to be asked to share their perceptions and experiences in more detail using probing and prompting strategies. Finally, the interview was planned to end in a respectful manner by asking the lecturers whether there was anything they wanted to add, followed by the researcher summarising what was said, and finally thanking them for their participation.

4.10 ANALYSIS OF INTERVIEW DATA

To review, different approaches for analysing interview data were considered and thematic analysis was selected as the preferred method for two reasons. First, thematic analysis is applicable to a variety of philosophical stances including essentialist, realist, or constructionist (Braun & Clarke, 2006) as mentioned in Chapter Three. Second, thematic analysis is one of the most common method used to analyse qualitative data (Thomas & Harden, 2007), because thematic analysis involves identifying, analysing, reporting patterns or themes within data and providing a rich description of the data (Braun & Clarke, 2006).

The six phases of thematic analysis: *Familiarisation with data*; *Coding*; *Searching for themes*; *Reviewing themes*; *Defining and naming themes*; and *Writing up* were to be used to analyse the focus group and semi-structured interview data (see Table 3.8). In the first phase, data was to be transcribed, read and reread to note initial ideas. In the second phase, coding was to be carried out to generate codes and collate data relevant to each code. In the third phase, themes were to be generated from the collated codes. In the fourth phase, themes generated were to be reviewed to determine whether the codes generated were relevant to the themes. In the fifth phase, names were to be assigned to each theme. The final phase was to involve the analysis in relation to the research questions and writing of the final report.

4.11 RESEARCH SCHEDULE

The overall research candidature plan is presented in detail in Appendix 5. A summary of the implementation activities that took place at the research site in the six-week data collection period is presented in Table 4.10.

Table 4.10. Summary of implementation activities during data collection

Research stage and timing	**Activities**
Logistics	
Aug 1, 2014	Prepare research site
Aug 2, 2014	Contact participants
Aug 3, 2014	Draw up interview schedule
Aug 3, 2014	Make interview room arrangements
Data collection	
Aug 4, 2014	Administer survey
Aug 4 – Sept 8, 2014	Monitor survey completions
Aug 4, 2014	Arrange interview schedule
Aug 4 – Aug 30, 2014	Administer pre-service teacher focus group
Aug 4 – Aug 30, 2014	Administer lecturer semi-structured interviews
Aug 4 – Aug 30, 2014	Listen to interview recordings
Aug 4 – Aug 30, 2014	Upload interview data on UNE Moodle
Aug 8 – Aug 30, 2014	Receive advice from research supervisors who will review interview data
Aug 31, 2014	Analyse interview data for member check
Sept 4, 2014	Complete member check (only for lecturer semi-structured interview data)

4.12 CHAPTER CONCLUSION

This chapter presented the research plan including survey, focus group interview and semi-structured interview development. The first part of the plan dealt with the web-based surveys for both pre-service teachers and lecturers with the relevant details provided for survey development, administration and analysis. The second part of the plan dealt with interview development, administration, and analysis of the qualitative data gathered through pre-service teacher focus group interviews and lecturer semi-structured interviews. The four chapters that follow present the quantitative and qualitative results of the study.

CHAPTER FIVE

PRE-SERVICE TEACHER SURVEY RESULTS

This chapter presents the results for the pre-service teacher web-based survey, and is divided into seven sections. The first section provides the demographic data of the pre-service teachers who responded to the survey. The second section presents the results for the survey items focusing on attitudes towards GNH and GNH in education. The third section presents the results for the survey items on attitudes towards ICT in education. The fourth section presents the results of the survey items dealing with attitudes towards ICT enhancing GNH principle and values. The fifth section presents the survey items used to assess pre-service teacher Technological Pedagogical and Content Knowledge (TPACK). The sixth section examines the internal reliability of the web-based survey items. The seventh section provides a conclusion to the chapter.

5.1 PRE-SERVICE TEACHER DEMOGRAPHICS

This section provides background information about the pre-service teachers who responded to the survey, in particular, survey response rates, age and sex of the respondents, and type of enrolment programme.

5.1.1 Response rates

The response rates for the pre-service teacher survey are presented in Table 5.1. Pre-service teachers in the earlier years of study (First Year and Second Year) had a higher response rate than pre-service teachers in the later years of study (Third Year and Fourth Year). Anecdotal evidence suggested that there is a decrease in participation rates generally for university activities across the years. This was a trend that may be reflected in the response rates for the study, which also progressively decreased according to pre-service teachers' year of study. The lower response rate for Third Year pre-service teachers could also have been due to the fact that there pre-service teachers were engaged in a Teaching Practicum during the time the survey was completed. However, the overall response rate of the study (68%) was considered to be adequate as it is difficult and expensive to achieve a response rate greater than 75% for a web-based survey (Nulty, 2008).

Table 5.1. Response rates

Sample	Potential Sample (n)	Respondents (n)	Response Rate (%)
First Year	248	225	91
Second Year	260	220	85
Third Year	276	143	52
Fourth Year	261	122	47
Total	1045	710	68

5.1.2 Pre-service teacher age and sex

The age and sex of pre-service teacher respondents are presented in Table 5.2. The age range of respondents was from 18 years to over the age of 24. The majority of respondents were aged between 20 and 24 years. The age profile of the respondents was considered to approximate that of the pre-service teacher population at the college. Overall, there were a similar number of males and females who responded, which approximates the pre-service teacher population at the college. So, the study sample was considered to be reasonably representative of the study population in relation to age and sex.

Table 5.2. Pre-service teacher age and sex

Age (Years)	Male (n)	Female (n)	Total (n)
18	5	8	13
19	18	43	61
20	35	69	104
21	75	70	145
22	86	62	148
23	55	43	98
24	43	28	71
Over 24	55	30	85
Total	372	353	725

5.1.3 Pre-service teacher enrolment

The pre-service teacher enrolment programme data are presented in Table 5.3. Pre-service teachers were enrolled across three different programmes. The study sample represented similar proportions to those enrolled in these three programmes at the college. So, the study sample was considered to be reasonably representative of the study population in relation to erolment programme.

Table 5.3. Pre-service teacher enrolment programme

Programme	Male (n)	Female (n)	Total (n)
BEd (Primary)	225	274	499
BEd (Dzongkha)	75	34	109
BEd (Secondary)	75	48	123
Total	375	356	731

5.2 ATTITUDES TOWARDS GNH AND GNH IN EDUCATION

Three survey items asked pre-service teachers to assess their attitudes towards GNH and GNH in education using a five point Likert scale: 1. Strongly disagree (SD), 2. Disagree (D), 3. Neither agree nor disagree (NAD), 4. Agree (A), 5. Strongly agree (SD). In the body of the text and in all tables displaying statistical values, the standard deviation is abbreviated as S.D.

5.2.1 Frequency Analysis

Frequencies of responses to these three survey items are presented in Table 5.4.

Table 5.4. Attitudes towards GNH and GNH in Education

Item	SD	D	NAD	A	SA	Mean	S.D.
I believe I possess adequate knowledge about GNH principles and values	5 (0.7%)	25 (3.7%)	127 (18.9%)	455 (67.8%)	59 (8.8%)	3.8	0.67
I believe GNH should be infused into my day-to-day teaching	4 (0.6%)	8 (1.2%)	23 (3.4%)	366 (54.5%)	270 (40.2%)	4.3	0.66
I believe it is necessary for the pre-service teacher curriculum in Bhutan to reflect GNH	1 (0.1%)	9 (1.3%)	21 (3.1%)	393 (58.8%)	244 (36.5%)	4.3	0.61

Note: SD - Strongly disagree; D - Disagree; NAD - Neither agree or disagree; A - Agree; SA - Strongly agree

The survey results showed that pre-service teacher attitudes towards GNH and GNH in education were positive. However, pre-service teachers were less confident that they possessed adequate knowledge of GNH principles and values (M=3.8, SD=0.67) compared to the two other survey items (M=4.3, SD=0.66 and M=4.3, SD=0.61 respectively). So while pre-service teachers were positive towards the infusion of GNH principles and values into day-to-day teaching and the pre-service curriculum, they were less confident that they have adequate knowledge of GNH principles and values in order to achieve these outcomes.

5.2.2 Pre-service teacher perceptions according to sex

Independent t-tests were conducted to determine whether any statistically significant differences existed between male and female pre-service teacher perceptions for these three survey items. The results are presented in Appendix Six (Table A.6.1). A statistically significant difference (i.e., $p < 0.05$) was identified between male and female responses for only one item:

- *I believe I possess adequate knowledge about GNH principles and values* - Males (M=3.87, SD =0.62), Females (M=3.74, SD =0.72), t(647)=2.46, p= 0.01.

Male pre-service teachers were more confident that they possessed adequate knowledge about GNH principles and values than female pre-service teachers

5.2.3 Pre-service teacher perceptions according to age

ANOVA was conducted to determine whether any statistically significant differences existed based upon pre-service teacher age for these three survey items. To aid in the analysis and interpretation of results, age data was re-coded into four groups: 18 - 19 years of age; 20 - 21 years of age; 22 - 23 years of age; and 24 years of age and over. The complete results are presented in Appendix Six (Table A.6.2). A statistically significant difference (i.e., $p < 0.05$) was identified for one item:

- *I believe GNH should be infused into my day-to-day teaching* ($F(3,664)=2.71$, $p=0.04$).

Despite a significant ANOVA result, Post Hoc Tests (Scheffe and Bonferonni) failed to identify any statistically significant differences between the age groups for this item. The age variable was then re-coded into three groups: 18-20 years of age; 21-22 years of age; and 23 years and over. Repeating the Post Hoc Tests (Scheffe and Bonferonni) with the re-coded variables indicated there was no significant difference between the teaching experience groups for this item. Thus, to avoid the possibility of a Type I error (i.e., a false positive) it was decided that there were no statistically significant differences between the groups for this item.

5.2.4 Pre-service teacher perceptions according to enrolment programme

ANOVA was conducted to determine whether any statistically significant differences existed based upon enrolment programme for these three survey items. The results are presented in Appendix Six (Table A.6.3). Statistically significant differences (i.e., $p < 0.05$) were identified for two items:

- *I believe I possess adequate knowledge about GNH principles and values* (F(2,668)=6.01, p=0.00).
- *I believe GNH should be infused into my day-to-day teaching* (F(2,668)=4.65, p=0.01).

For the first item, Post Hoc Tests (Scheffe and Bonferonni), identified a significant difference between pre-service teachers enrolled in the BEd (Primary) and those enrolled in the BEd (Dzongkha). The mean score of the BEd (Dzongkha) group (M=4.01, SD=0.66) was significantly higher than the mean score of the BEd (Primary) group (M=3.76, SD=0.64). This indicates that pre-service teachers enrolled in the BEd (Dzongkha) were more confident of their knowledge of GNH principles and values than pre-service teachers enrolled in the BEd (Primary).

For the second item, Post Hoc Tests (Scheffe and Bonferonni), identified a significant difference between pre-service teachers enrolled in the BEd (Primary) and pre-service teachers enrolled in the BEd (Secondary). The mean score of the BEd (Primary) group (M=4.36, SD=0.66) was significantly higher than the mean score of the BEd (Secondary) group (M=4.14, SD=0.71). This indicates that pre-service teachers enrolled in the BEd (Primary) were more supportive of GNH being infused into their day-to-day teaching than pre-service teachers enrolled in the BEd (Secondary).

5.2.5 Pre-service teacher perceptions according to year of study

ANOVA was conducted to determine whether any statistically significant differences existed based upon pre-service teacher year of study. The full results are presented in Appendix Six (Table A.6.4). No statistically significant differences (i.e., $p < 0.05$) were identified for these three items indicating that the year of study of pre-service teachers did not influence their attitudes towards GNH and GNH in education.

5.3 ATTITUDES TOWARDS ICT IN EDUCATION

Ten survey items asked pre-service teachers to assess their attitudes towards ICT in education using a five point Likert scale: 1. Strongly disagree (SD), 2. Disagree (D), 3. Neither agree nor disagree (NAD), 4. Agree (A), 5. Strongly agree (SA).

5.3.1 Frequency Analysis

Frequencies of the responses to these ten survey items are presented in Table 5.5.

Table 5.5 Attitudes towards ICT in Education

Item	SD	D	NAD	A	SA	Mean	S.D.
I believe ICT can make my teaching and learning more effective	5 (0.8%)	3 (0.4%)	9 (1.4%)	290 (44%)	358 (54%)	4.5	0.63
I believe the use of ICT tools make learning activities more efficient	3 (0.4%)	7 (1.0%)	12 (1.8%)	341 (51%)	305 (46%)	4.4	0.63
I believe ICT enhances the way I learn	4 (0.6%)	6 (0.9%)	26 (3.9%)	388 (58.42%)	240 (36.1)%	4.2	0..64
I believe ICT is an effective tool to create conducive learning environments for learners	0 (0%)	11 (1.6%)	53 (7.9%)	422 (63.3%)	181 (27.1%)	4.2	0.63
I believe ICT is a good tool to engage students	0 (0%)	13 (1.9%)	38 (5.7%)	365 (54.6)	252 (37.7%)	4.3	0.45
I believe ICT can make learning more efficient	1 (0.2%)	4 (0.6%)	32 (4.9%)	432 (65.8%)	188 (28.6%)	4.2	0.57
I believe ICT can improve the quality of education	2 (0.3%)	17 (2.6%)	60 (9.1%)	354 (53.5%)	229 (34.6%)	4.2	0.73
I believe ICT can improve the academic performance of learners	5 (0.8%)	20 (3.0%)	72 (10.9%)	415 (62.9%)	148 (22.4%)	4.0	0.72
I believe using ICT has the potential to improve one's ability to teach	1 (0.2%)	7 (1.1%)	44 (6.6%)	409 (61.5%)	204 (30.7%)	4.2	0.62
I believe it is possible to change learning from passive to active using ICT tools	2 (0.3%)	11 (1.7%)	60 (9.1%)	435 (66.3%)	148 (22.6%)	4.1	0.64

Note: SD - Strongly disagree; D - Disagree; NAD - Neither agree or disagree; A - Agree; SA - Strongly agree

Pre-service teacher attitudes towards ICT were strongly positive with the majority of pre-service teachers either agreeing or strongly agreeing for all ten items in this category. The low standard deviations suggest a high level of consensus amongst pre-service teachers for all ten items. Although the responses were strongly positive, three items, *I believe ICT can improve the quality of education, I believe ICT can improve the academic performance of learners,* and *I believe it is possible to change learning from passive to active using ICT tools*, had a relatively large number of neither agree nor disagree (NAD) responses (more than 9%) suggesting uncertainly for some pre-service teachers in these areas.

5.3.2 Pre-service teacher attitudes according to sex

Independent t-tests were conducted to determine whether any statistically significant differences existed between male and female pre-service teachers for these ten survey items. The complete results are presented in Appendix Six (Table A.6.1). A statistically

significant difference (i.e., p <0.05) was identified between male and female responses for one item:

- *I believe ICT enhances the way I* learn - Males (M=4.34, SD =0.64), Females (M=4.24, SD=0.64), t(657)=2.04, p= 0.04.

Male pre-service teachers had a higher overall mean than female pre-service teachers indicating that male pre-service teachers believed more strongly, than the females, that ICT enhances the way they learn.

5.3.3 Pre-service teacher attitudes according to age

ANOVA was conducted to determine whether any statistically significant differences existed based upon pre-service teacher age for these ten survey items. As with previous analysis, age data was re-coded into four groups: 18-19 years of age; 20-21 years of age; 22-23 years of age; and 24 years of age and over. The complete results are presented in Appendix Six (Table A.6.2). A statistically significant difference (i.e., p <0.05) was identified for one item:

- *I believe using ICT has the potential to improve one ability one's ability to teach* (F(3,658)=4.14, p=0.01).

Post Hoc Tests (Scheffe and Bonferonni) identified a statistically significant difference between pre-service teachers in the 18-19 years of age group and the 22-23 years of age group. Pre-service teachers in the 22-23 years of age group had a significantly higher mean (M=4.30, SD=0.61) than pre-service teachers in 18-19 years of age group (M=4.02, SD=0.73). This indicates that pre-service teachers in the 22-23 years of age group believed more strongly that ICT has the potential to improve one's ability to teach than pre-service teachers in 18-19 years of age group.

5.3.4 Pre-service teacher attitudes according to enrolment programme

ANOVA was conducted to determine whether any statistically significant differences existed based upon enrolment programme for these ten survey items. The results are presented in Appendix Six (Table A.6.3). A statistically significant difference (i.e., p <0.05) was identified for one item:

- *I believe ICT can improve the academic performance of learners* (F(2,657)=3.55, p=0.03).

Post Hoc Tests (Scheffe and Bonferonni) identified a statistically significant difference between pre-service teachers in the BEd (Primary) group and the BEd (Dzongkha) group. Pre-service teachers in the BEd (Dzongkha) group had a significantly higher mean (M=4.19, SD=0.53) than pre-service teachers in BEd (Primary) group (M=3.99, SD=0.76). This indicates that the BEd (Dzongkha) group believed more strongly that ICT can improve the academic performance of learners than pre-service teachers in BEd (Primary) group.

5.3.5 Pre-service teacher attitudes according to year of study

ANOVA was conducted to determine whether any statistically significant differences existed based upon pre-service teacher year of study. The full results are presented in Appendix Six (Table A.6.4). Statistically significant differences (i.e., $p < 0.05$) were identified for four items:

- *I believe I the use of ICT tools make learning activities more efficient* (F(3,656)=2.85, p=0.04).
- *I believe ICT can make learning more efficient* (F(3,645)=3.80, p=0.01).
- *I believe ICT can improve the academic performance of learners* (F(3,650)=3.33, p=.02)
- *I believe using ICT has the potential to improve one ability one's ability to teach* (F(3,653)=4.34, p=0.05).

For the first item, Post Hoc Tests (Scheffe and Bonferonni), identified a significant difference between pre-service teachers enrolled in the Second Year and Third Year. The mean score of the Third Year group (M=4.51, SD=0.57) was significantly higher than the mean score of the Second Year group (M=4.31, SD=0.58). This indicates that Third Year pre-service teachers believed more strongly than Second Year pre-service teachers that ICT tools can make learning activities more efficient.

For the second item, Post Hoc Tests (Scheffe and Bonferonni), identified a significant difference between pre-service teachers enrolled in First Year and Second Year. The mean score of the First Year group (M=4.30, SD=0.56) was significantly higher than the mean score of the Second Year group (M=4.12, SD=0.57). This indicates that First Year pre-service teachers believed more strongly than Second Year pre-service teachers that ICT can make learning more efficient.

For the third item, Post Hoc Tests (Scheffe and Bonferonni), identified a significant difference between pre-service teachers enrolled in Third Year and Fourth Year. The mean score of the Third Year group (M=4.16, SD=0.65) was significantly higher than

the mean score of the Fourth Year group (M=3.91, SD=0.72). This indicates that Third Year pre-service teachers believed more strongly than Fourth Year pre-service teachers that ICT can improve the academic performance of learners.

For the Fourth item, Post Hoc Tests (Scheffe and Bonferonni), identified a significant difference between pre-service teachers enrolled in First Year and Third Year. Post Hoc Tests also identified a significant difference between pre-service teachers enrolled in Second Year and Third Year. The mean score of the Third Year group (M=4.35, SD=0.60) was significantly higher than both the mean scores of the First Year group (M=4.12, SD=0.67) and Second Year group (M=4.17, SD=0.56). This indicates that Third Year pre-service teachers believed more strongly than both First Year and Second Year pre-service teachers that ICT has the potential to improves one's ability to teach.

5.4 ATTITUDES TOWARDS ICT ENHANCING GNH PRINCIPLES AND VALUES

Seventeen survey items asked pre-service teachers to assess their attitudes towards ICT enhancing GNH principles and values using a five point Likert scale: 1. Strongly disagree (SD), 2. Disagree (D), 3. Neither agree nor disagree (NAD), 4. Agree, 5. Strongly agree (SA).

5.4.1 Frequency Analysis

Frequencies of responses to the seventeen survey items are presented in Table 5.6.

Table 5.6. Attitudes towards ICT enhancing GNH principles and values

Item	SD	D	NAD	A	SA	Mean	S.D.
I believe ICT has the potential to make me a more imaginative student	3 (0.5%)	15 (2.3%)	51 (7.7%)	368 (55.4%)	227 (34.2%)	4.2	0.71
I believe ICT tools can help enhance creativity	2 (0.3%)	21 (3.2%)	43 (6.5%)	361 (54.4%)	236 (35.6)	4.2	0.73
I believe ICT tools have the potential to effectively internalise GNH values	1 (0.2%)	16 (2.4%)	125 (18.9%)	424 (64.0%)	97 (14.6%)	3.9	0.66
I believe ICT can be an effective tool to foster GNH to better become part of our lives	1 (0.2%)	20 (3.0%)	94 (14.1%)	446 (67%)	105 (15.8%)	4.0	0.66
I believe ICT tools can make learning more enjoyable	1 (0.2%)	2 (0.3%)	13 (2.0%)	316 (47.5%)	333 (50.1%)	4.5	0.57
I believe ICT tools can make learning more relevant	1 (0.2%)	1 (0.2%)	33 (5.0%)	433 (65.2%)	196 (29.5%)	4.2	0.56
I believe GNH values are enhanced more efficiently using ICT tools	4 (0.6%)	37 (5.6%)	149 (22.4%)	385 (57.9%)	90 (13.5%)	3.8	0.77

Item	SD	D	NAD	A	SA	Mean	S.D.
I believe ICT is an efficient tool to enhance GNH values such as integrity	1 (0.2%)	18 (2.7%	137 (20.7%)	441 (66.5%)	66 (10%)	3.8	0.63
I believe ICT is an efficient tool to enhance my motivation to learn	3 (0.5%)	8 (1.2%)	34 (5.1%)	426 (64.3%)	192 (29%)	4.2	0.63
I believe the use of ICT tools aid in enhancing critical thinking skills	3 (0.5%)	33 (5.0%)	74 (11.2%)	423 (64%)	128 (19.4%)	4.0	0.74
I believe that using ICT tools enhance my ability to collaborate efficiently	2 (0.3%)	12 (1.8%)	86 (13.1%)	447 (67.9%)	111 (16.9%)	4.0	0.63
I believe ICT tools possess the potential to make me become more reflective	2 (0.3%)	2 (3.0%)	68 (10.2%)	460 (69.3%)	114 (17.2%)	4.0	0.65
I believe ICT is a good tool to help one become more mindful about I do	1 (0.2%)	39 (5.9%)	117 (17.7%)	401 (60.8%)	102 (15.5%)	3.9	0.75
I believe ICT is an effective tool to learn about media literacy	1 (0.2%)	1 (0.2%)	19 (2.9%)	354 (53.3%)	289 (43.5%)	4.4	0.57
I believe ICT has the potential to create lifelong learners	1 (0.2%)	20 (3.0%)	64 (9.7%)	390 (59.0%)	186 (28.1%)	4.1	0.71
I believe using ICT tools can improve a learner's emotional well-being	2 (0.3%)	39 (5.9%)	164 (24.6%)	375 (56.3%)	86 (12.9%)	3.8	0.76
I believe using ICT can empower a learner	0 (0.0%)	9 (1.4%)	40 (5.0%)	465 (70.1%)	149 (22.5%)	4.1	0.57

Note: SD - Strongly disagree; D - Disagree; NAD - Neither agree or disagree; A - Agree; SA - Strongly agree

Results suggest that pre-service teachers held positive attitudes towards ICT enhancing GNH principles and values. There were six survey items that received overwhelmingly positive responses (i.e., > 90% agree or strongly agree). These were:

- *I believe ICT tools can help enhance creativity* (90.0% agree or strongly agree).
- *I believe ICT tools can make learning more enjoyable* (97.6% agree or strongly agree).
- *I believe ICT tools can make learning more relevant* (94.7% agree or strongly agree).
- *I believe ICT is an efficient tool to enhance my motivation to learn* (93.3% agree or strongly agree).
- *I believe ICT is an effective tool to learn about media literacy* (96.8% agree or strongly agree).
- *I believe using ICT can empower a learner* (92.6% agree or strongly agree).

Despite the range of positive responses (i.e., agree or strongly agree) for the survey items, for a number of items there were relatively large responses of neither agree nor disagree. These items were:

- *I believe ICT tools have the potential to effectively internalise GNH values* (18.9%).

- *I believe ICT can be an effective tool to foster GNH to better become part of our lives* (14.1%).
- *I believe GNH values are enhanced more efficiently using ICT tools* (22.4%).
- *I believe ICT is an efficient tool to enhance GNH values such as integrity* (20.7%).
- *I believe ICT is a good tool to help one become more mindful about what I do* (17.7%).
- *I believe using ICT tools can improve a learner's emotional well-being* (24.6%).

Importantly, the first three survey items in this list related ICT to GNH principles and values *in general*. Survey items relating the use of ICT to *specific* GNH principles and values such as creativity, enjoyment and relevance generally had less levels of uncertainty. However, the last three items in this list were about specific GNH principles and values, integrity, mindfulness and emotional well-being. The relatively large uncertainty in the responses to these items may be due to these principles and values being poorly understood by the pre-service teachers.

5.4.2 Pre-service teacher attitudes by sex

Independent t-tests were conducted to determine whether any statistically significant differences existed between male and female pre-service teachers for these seventeen survey items. The complete results are presented in Appendix Six (Table A.6.1). Statistically significant differences (i.e., $p < 0.05$) were identified between male and female pre-service teacher responses for two items:

- *I believe ICT has the potential to effectively internalise GNH values* - Males (M=3.96, SD =0.64), Females (M=3.84, SD =0. 68), t(650)=2.34, p= 0.02).
- *I believe using ICT tools can improve a learner's emotional well-being* - Males (M=4.85, SD =0.72), Females (M=3.67, SD =0.79), t(650)=3.02, p= 0.03).

For both items, male pre-service teachers had a higher overall mean than female pre-service teachers indicating that male pre-service teachers believed more strongly than female pre-service teachers that both ICT has the potential to effectively internalise GNH values and using ICT tools can improve a learner's emotional well-being.

5.4.3 Pre-service teacher attitudes according to age

ANOVA was conducted to determine whether any statistically significant differences existed based upon pre-service teacher age for these seventeen survey items. As with previous analysis, age data was re-coded into four groups: 18-19 years of age; 2 -21 years of age; 22 - 23 years of age; and 24 years of age and over. The complete results are

presented in Appendix Six (Table A.6.2). No statistically significant differences (i.e., $p < 0.05$) were identified for these items indicating that the age of pre-service teachers did not influence their perceptions about pre-service teacher attitudes towards ICT enhancing GNH principles and values.

5.4.4 Pre-service teacher attitudes according to enrolment programme

ANOVA was conducted to determine whether any statistically significant differences existed based upon enrolment programme for these seventeen survey items. The results are presented in Appendix Six (Table A.6.3). Statistically significant differences (i.e., $p < 0.05$) were identified for five items:

- *I believe ICT can be an effective tool to foster GNH to better become part of our lives* ($F(2, 663)=6.03$, $p=0.00$).
- *I believe GNH values are enhanced more efficiently using ICT tools* ($F(2,662)=4.39$, $p=0.01$).
- *I believe ICT tools possess the potential to make me become more reflective* ($F(2,661)=4.37$, $p=0.01$).
- *I believe ICT is a good tool to help me become more mindful about what I do* ($F(2,657)=8.47$, $p=0.00$).
- *I believe using ICT tools can improve a learner's emotional well-being* ($F(2,663)=12.50$, $p=0.00$).

For the first item, Post Hoc Tests (Scheffe and Bonferonni) identified a statistically significant difference between pre-service teachers in BEd (Primary) group and the BEd (Dzongkha) group. Pre-service teachers in the BEd (Dzongkha) group had a significantly higher mean ($M=4.13$, $SD=0.54$) than pre-service teachers in BEd (Primary) group ($M=3.90$, $SD=0.66$). This indicates that the BEd (Dzongkha) group believed more strongly that ICT can be an effective tool to foster GNH to better become part of their lives than pre-service teachers in BEd (Primary) group.

For the second item, Post Hoc Tests (Scheffe and Bonferonni) identified a statistically significant difference between pre-service teachers in the BEd (Primary) group and the BEd (Dzongkha) group. Pre-service teachers in the BEd (Dzongkha) group had a significantly higher mean ($M=3.97$, $SD=0.62$) than pre-service teachers in BEd (Primary) group ($M=3.73$, $SD=0.79$). This indicates that the BEd (Dzongkha) group believed more strongly that GNH values are enhanced more efficiently using ICT tools than pre-service teachers in BEd (Primary) group.

For the third item, Post Hoc Tests (Scheffe and Bonferonni) identified a statistically significant difference between pre-service teachers in BEd (Primary) group and the BEd (Dzongkha) group. Pre-service teachers in the BEd (Dzongkha) group had a significantly higher mean (M=4.17, SD=0.53) than pre-service teachers in BEd (Primary) group (M=3.96, SD=0.68). This indicates that the BEd (Dzongkha) group believed more strongly that ICT tools possess the potential to make them become more reflective than pre-service teachers in BEd (Primary) group.

For the fourth item, Post Hoc Tests (Scheffe and Bonferonni) identified a statistically significant difference between pre-service teachers in BEd (Primary) group and the BEd (Dzongkha) group. Post Hoc Tests (Scheffe and Bonferonni) also identified a statistically significant difference between pre-service teachers in BEd (Primary) group and the BEd (Secondary) group. Pre-service teachers in both the BEd (Dzongkha) group and the BEd (Secondary) group had significantly higher means (M=4.03, SD=0.56 and M=4.04, SD=0.73, respectively) than pre-service teachers in the BEd (Primary) group (M=3.78, SD=0.78). This indicates that both the BEd (Dzongkha) group and the BEd (Secondary) group believed more strongly that ICT is a good tool to help me become more mindful about what they do than pre-service teachers in BEd (Primary) group.

For the fifth item, Post Hoc Tests (Scheffe and Bonferonni) identified a statistically significant difference between pre-service teachers in BEd (Primary) group and the BEd (Dzongkha) group. Post Hoc Tests (Scheffe and Bonferonni) also identified a statistically significant difference between pre-service teachers in BEd (Primary) group and the BEd (Secondary) group. Pre-service teachers in both the BEd (Dzongkha) group and the BEd (Secondary) group had significantly higher means (M=4.05, SD=0.58 and M=3.88, SD=0.76, respectively) than pre-service teachers in the BEd (Primary) group (M=3.67, SD=0.77). This indicates that pre-service teachers in both the BEd (Dzongkha) group and the BEd (Secondary) group believed more strongly that ICT using ICT tools can improve a learner's emotional well-being than pre-service teachers in BEd (Primary) group.

5.4.5 Pre-service teacher attitudes according to year of study

ANOVA was conducted to determine whether any statistically significant differences existed based upon pre-service teacher year of study for these seventeen survey items.

The full results are presented in Appendix Six (Table A.6.4). Statistically significant differences (i.e., $p < 0.05$) were identified for four items:

- *I believe ICT has the potential to make me a more imaginative* student ($F(3,652)=3.13$, $p=0.03$).
- *I believe ICT tools can help enhance creativity* ($F(3,651)=3.71$, $p=0.01$).
- *I believe ICT tools have the potential to effectively internalise GNH values* ($F(3,652)=3.75$, $p=0.01$).
- *I believe ICT is a good tool to help me become more mindful about what I do* ($F(3,648)=4.74$, $p=0.00$).

For the first item, Post Hoc Tests (Scheffe and Bonferonni), identified a significant difference in attitudes between pre-service teachers enrolled in the Second Year and Fourth Year. The mean score of the Fourth Year group ($M=4.51$, $SD=0.66$) was significantly higher than the mean score of the Second Year group ($M=4.08$, $SD=0.75$). This indicates that Fourth Year pre-service teachers believed more strongly than Second Year pre-service teachers that ICT has the potential to make them more imaginative pre-service teachers.

For the second item, Post Hoc Tests (Scheffe and Bonferonni) identified a statistically significant difference between pre-service teachers in First Year group and the Second Year group. Post Hoc Tests (Scheffe and Bonferonni) also identified a statistically significant difference between pre-service teachers in Second Year group and the Third Year group. Pre-service teachers in both the First Year group and the Third Year group had significantly higher means ($M=4.27$, $SD=0.68$ and $M=4.31$, $SD=0.73$, respectively) than pre-service teachers in the Second Year group ($M=4.08$, $SD=0.75$). This indicates that pre-service teachers in both the First Year group and the Third Year group believed more strongly that ICT tools can help enhance creativity than pre-service teachers in the Second Year group.

For the third item, Post Hoc Tests (Scheffe and Bonferonni), identified a significant difference between pre-service teachers enrolled in First Year and Second Year. The mean score of the First Year group ($M=4.00$, $SD=0.62$) was significantly higher than the mean score of the Fourth Year group ($M=3.76$, $SD=0.74$). This indicates that First Year pre-service teachers believed more strongly than Fourth Year pre-service teachers that ICT tools have the potential to effectively internalise GNH values.

For the fourth item, Post Hoc Tests (Scheffe and Bonferonni) identified a statistically significant difference between pre-service teachers in the First Year group and the Second Year group. Post Hoc Tests (Scheffe and Bonferonni) also identified a statistically significant difference between pre-service teachers in First Year group and the Fourth Year group. Pre-service teachers in the First Year group had a significantly higher mean (M=3.97, SD=0.72) than pre-service teachers in both the Second Year group (M=3.87, SD=0.66) and the Fourth Year group (M=3.71, SD=0.81). This indicates that pre-service teachers in the First Year group believed more strongly that ICT is a good tool to help them become more mindful about what they do, than pre-service teachers in both the Second Year and Fourth Year groups.

5.5 PRE-SERVICE TEACHER TPACK

Pre-service teachers were asked to assess their own TPACK using a five point Likert scale: 1. Strongly disagree (SD), 2. Disagree (D), 3. Neither agree nor disagree (NAD), 4. Agree (A), 5. Strongly agree (SA). For convenience and clarity, the responses to these survey items are presented in four sections corresponding to the four dimensions surveyed: *Technological Knowledge* (TK); *Technological Content Knowledge* (TPK); *Technological Content Knowledge* (TCK); and *Technological Pedagogical Content Knowledge* (TPACK).

5.5.1 Frequency Analysis

Technological Knowledge (TK)

Six survey items assessed pre-service teacher Technological Knowledge (TK). Frequencies of responses to these six items are presented in Table 5.7.

Table 5.7. Pre-service teacher Technological Knowledge (TK)

Item	SD	D	NAD	A	SA	Mean	S.D.
I know how to solve my own technical problems	27 (4.2%)	172 (26.7%)	202 (31.3%)	225 (34.9%)	19 (2.9%)	3.1	0.95
I learn technology easily	11 (1.7%)	129 (20.0%)	188 (29.2%)	277 (43.6%)	39 (6.1%)	3.3	0.92
I keep up with new technologies	2 (0.3%)	105 (16.3%)	163 (25.3%)	340 (52.9%)	33 (5.1%)	3.5	0.84
I frequently play around with the technology	3 (0.5%)	66 (10.2%)	96 (14.9%)	400 (62.0%)	80 (12.4%)	3.8	0.82
I know a lot about different technologies	20 (2.5%)	174 (27.2%)	240 (37.5%)	188 (29.4%)	18 (2.8%)	3.0	0.90
I have the technical skills needed to use technology	12 (1.9%)	146 (22.7%)	205 (31.9%)	263 (41.0%)	12 (2.5%)	3.2	0.88

Note: SD - Strongly disagree; D - Disagree; NAD - Neither agree or disagree; A - Agree; SA - Strongly agree

A majority of pre-service teachers (> 50%) agreed or strongly agreed for only two items: *I keep up with new technologies* and *I frequently play around with the technology*. The remaining four survey items were characterised by a relatively high degree of uncertainty and low overall means. Results suggest that although pre-service teachers like to keep appraised of new technology and are willing to play around with it, their overall confidence in their knowledge of and ability to use technology is relatively low.

Technological Pedagogical Knowledge (TPK)

Five survey items assessed pre-service teacher Technological Pedagogical Knowledge (TPK).

Frequencies of responses to these five items are presented in Table 5.8.

Table 5.8. Pre-service teacher Technological Pedagogical Knowledge (TPK)

Item	SD	D	NAD	A	SA	M	S.D.
I know how to choose technologies that enhance student learning for a lesson	1 (0.2%)	66 (10.3%)	145 (22.7%)	391 (61.1%)	37 (5.8%)	3.6	0.75
I know how choose appropriate technologies to enhance teaching approaches for a lesson	9 (1.4%)	89 (13.8%)	160 (24.8%)	353 (54.8%)	33 (5.1%)	3.5	0.85
I think critically about how to use technology in the classroom	10 (1.6%)	71 (11.0%)	153 (23.8%)	381 (59.3%)	28 (4.4%)	3.5	0.81
I am confident to customise the technology that I own to different teaching activities	1 (4%)	4 (16%)	8 (32%)	12 (48%)	0 (0%)	3.4	0.82
I am able to select appropriate technologies to use in my classroom to enhance what I teach	0 (0%)	4 (15.4%)	5 (19.2%)	16 (61.5%)	1 (3.8%)	3.6	0.79

Note: SD - Strongly disagree; D - Disagree; NAD - Neither agree or disagree; A - Agree; SA - Strongly agree

The overall means suggest that pre-service teachers were more confident in their Technological Pedagogical Knowledge (TPK) than they were for their Technological Knowledge (TK). However as for TK, pre-service teacher responses to the TPK items were also characterised by a relatively high degree of uncertainty for all items.

Technological Content Knowledge (TCK)

Three survey items assessed pre-service teacher Technological Content Knowledge (TPK). Frequencies of responses to these three items are presented in Table 5.9.

Table 5.9 Pre-service teacher Technological Content Knowledge (TCK)

Item	SD	D	NAD	A	SA	M	S.D.
I know how to choose appropriate technologies that enhance the development of GNH values in my lessons	8 (1.3%)	100 (15.6%)	217 (34%)	289 (45.2%)	25 (3.9%)	3.4	0.83
I know how to choose technologies that can enhance the content for a lesson	4 (0.6%)	58 (9.0%)	156 (24.1%)	391 (60.5%)	37 (5.7%)	3.6	0.75
I know how to select ICT that enhances what I teach	4 (0.6%)	69 (10.7%)	142 (22.1%)	404 (62.8%)	24 (3.7%)	3.6	0.76

The majority of pre-service teachers agreed or strongly agreed that they knew how to choose technologies that could enhance both content for a lesson and what they taught. However, over one third (34%) of pre-service teachers remained uncertain (neither agree nor disagree) about how to choose appropriate technologies that enhance the development of GNH values in lessons.

Technological Pedagogical Content Knowledge (TPACK)

Four survey items assessed pre-service teacher Technological Pedagogical and Content Knowledge (TPACK). Frequencies of responses to these four items are presented in Table 5.10.

Table 5.10. Pre-service teacher TPACK

Item	SD	D	NAD	A	SA	M	S.D.
I know how to use strategies that combine content, technologies and teaching approaches	7 (1.1%)	92 (14.4%)	198 (31.1)	323 (50.7%)	17 (2.7%)	3.4	0.81
I possess adequate skills to provide leadership in helping others to coordinate content, ICT and teaching approaches	10 (1.6%)	100 (15.6%)	211 (33.0%)	298 (46.6%)	21 (3.3%)	3.3	0.84
I am able to use strategies that combine content, ICT, and teaching approaches	5 (0.8%)	78 (12.2%)	213 (33.2%)	328 (51.2)	17 (2.7%)	3.4	0.77
I can appropriately combine, content, technologies and teaching approaches in a classroom lesson	7 (1.1%)	78 (12.2%)	0 (0.0%)	179 (28.1%)	356 (57.7%)	4.3	1.07

Note: SD - Strongly disagree; D - Disagree; NAD - Neither agree or disagree; A - Agree; SA - Strongly agree

Pre-service teacher TPACK was low for the application of strategies and leadership skills. However, pre-service teachers were overwhelmingly confident in being able to combine content, technologies and teaching approaches in a classroom lesson. Such results appear contradictory. This may be due to pre-service teachers either

misinterpreting the survey items or simply because pre-service teachers are more confident in the practical application of combining ICT, content and teaching approaches than they are in strategising or providing leadership in such activities.

5.5.2 Pre-service teacher TPACK according to sex

Independent t-tests were conducted to determine whether any statistically significant differences existed between male and female pre-service teachers for all TPACK items. Full results are presented in Appendix Six (Table A.6.5). Statistically significant differences (i.e., $p < 0.05$) were identified between male and female pre-service teachers responses for all TPACK items. In each instance, male pre-service teachers had a significantly higher mean than the female pre-service teachers. A breakdown of the results follows.

Technological Knowledge (TK)

Statistically significant differences (i.e., $p < 0.05$) were identified between male and female pre-service teacher responses for all six items in this category:

- *I know how to solve my own technical problems* - Males (M=3.30, SD =0.93), Females (M=2.81, SD =0.90), t(638)=6.82, p= 0.00.
- *I learn technology easily* - Males (M=3.47, SD =0.90), Females (M=3.16, SD =0.90), t(637)=4.36, p= 0.00.
- *I keep up with new technologies* - Males (M=3.59, SD =0.80), Females (M=3.33, SD =0.85), t(632)=3.94, p= 0.00.
- *I frequently play around with the technology* - Males (M=3.88, SD =0.74), Females (M=3.64, SD =0.87), t(619)=3.70, p= 0.00.
- *I know a lot about different technologies* - Males (M=3.19, SD =0.72), Females (M=2.83, SD =1.04), t(632)=5.25, p= 0.00.
- *I have the technical skills needed to use technology* - Males (M=3.38, SD =0.72), Females (M=3.01, SD =1.04), t(635)=5.46, p= 0.00.

Technological Pedagogical Knowledge (TPK)

Statistically significant differences (i.e., $p < 0.05$) were identified between male and female pre-service teacher responses for all five items in this category:

- *I know how to choose technologies that enhance students' learning for a lesson* - Males (M=3.76, SD =0.68), Females (M=3.44, SD =0.80), t(618)=4.72, p= 0.00.

- *I know how choose appropriate technologies to enhance teaching approaches for a lesson* - Males (M=3.63, SD =0.80), Females (M=3.34, SD =0.87), t(631)=4.48, p= 0.00.
- *I can think critically about how to use technology in the classroom* - Males (M=3.68, SD =0.75), Females (M=3.39, SD =0.84), t(627)=4.59, p= 0.00.
- *I am confident to customise the technology that I own to different teaching* activities - Males (M=3.61, SD =0.75), Females (M=3.16, SD =0.84), t(623)=7.16, p= 0.00.
- *I am able to select appropriate technologies to use in my classroom to enhance what I teach* - Males (M=3.79, SD =0.71), Females (M=3.49, SD =0.84), t(615)=4.84, p= 0.00.

Technological Content Knowledge (TCK)

Statistically significant differences (i.e., p <0.05) were identified between male and female pre-service teacher responses for all three items in this category:

- *I know how to choose technologies that enhance the development of GNH values in my lessons* - Males (M=3.48, SD =0.82), Females (M=3.21, SD =0.83), t(631)=4.21, p= 0.00.
- *I know how to choose technologies that can enhance the content for a lesson* - Males (M=3.79, SD =0.68), Females (M=3.45, SD =0.79), t(621)=5.84, p= 0.00.
- *I know how to select ICT that enhances what I teach* - Males (M=3.67, SD =0.72), Females (M=3.49, SD =0.79), t(630)=3.04, p= 0.00.

Technological Pedagogical Content Knowledge (TPACK)

Statistically significant differences (i.e., p <0.05) were identified between male and female pre-service teacher responses for all four items in this category:

- *I know how to use strategies that combine content, technologies and teaching approaches* - Males (M=3.60, SD =0.74), Females (M=3.18, SD =0.82), t(622)=6.76, p= 0.00.
- *I possess adequate skills to provide leadership in helping others to coordinate the use of content, technologies and teaching approaches* - Males (M=3.55, SD =0.74), Females (M=3.14, SD =0.88), t(614)=6.29, p= 0.00.
- *I am able to use strategies that combine content, ICT, and teaching approaches* - Males (M=3.68, SD =0.75), Females (M=3.39, SD =0.84), t(618)=5.62, p= 0.00.
- *I can appropriately combine content, ICT, and teaching approaches in a classroom lesson* - Males (M=4.55, SD =0.91), Females (M=4.12, SD =1.18), t(590)=5.09, p= 0.00.

For all TPACK components (i.e., TK, TPK, TCK, TPACK) male pre-service teachers had significantly higher means than female pre-service teachers. This means that male pre-service teacher rated themselves with better TPACK and its associated components than female pre-service teachers.

5.5.3 Pre-service teacher TPACK according to age

One-way ANOVA was conducted to determine whether any statistically significant differences existed for all TPACK items based upon age range. As in previous analyse, pre-service teacher age data was re-coded into four groups: 18-19 years of age; 20-21 years of age; 22-23 years of age; and 24 years of age and over. The results are presented in Appendix Six (Table A.6.6). A breakdown of the results follows.

Technological Knowledge (TK)

ANOVA was conducted to determine whether any statistically significant differences existed based upon pre-service teacher age for these six items. Statistically significant differences (i.e., $p < 0.05$) were identified for two items:

- *I know how to solve my own technical problems* ($F(3,639)=4.97$, $p=0.00$).
- *I keep up with new technologies* ($F(3,637)=3.02$, $p=0.03$).

For the first item, Post Hoc Tests (Scheffe and Bonferonni) identified a statistically significant difference between pre-service teachers in the 20-21 years of age group and the 22-23 years of age group. Pre-service teachers in the 22-23 years of age group had a significantly higher mean ($M=3.22$, $SD=0.94$) than pre-service teachers in the 20-21 years of age group ($M=2.90$, $SD=0.96$). This indicates that pre-service teachers in the 22-23 years of age group were more positive in their ability to solve their own technical problems than pre-service teachers in 20-21 years of age group.

For the second item, despite a significant ANOVA result, Post Hoc Tests (Scheffe and Bonferonni) failed to identify any statistically significant differences between the age groups for this item. The age variable was re-coded into three groups: 18-20 years of age; 21-22 years of age; and 23 years and over. Repeating the Post Hoc Tests (Scheffe and Bonferonni) with the re-coded variables indicated there was no significant difference between the age groups for this item. As previously, to avoid the possibility of a Type I error it was decided that there were no statistically significant differences between the age groups for this item.

Technological Pedagogical Knowledge (TPK)

ANOVA was conducted to determine whether any statistically significant differences existed based upon pre-service teacher age for these five items. Statistically significant differences (i.e., $p < 0.05$) were identified for four items:

- *I know how choose appropriate technologies to enhance teaching approaches for a lesson* ($F(3,638)=3.67$, $p = 0.01$).
- *I can think critically about how to use technology in the classroom* ($F(3,638)=2.87$, $p=0.04$).
- *I am confident to customise the technology that I own to different teaching activities* ($F(3,635)=7.64$, $p=0.00$).
- *I am able to select appropriate technologies to use in my classroom to enhance what I teach* ($F(3,635)=4.31$, $p=0.01$).

For the first item, Post Hoc Tests (Scheffe and Bonferonni) identified a statistically significant difference between pre-service teachers in the 18-19 years of age group and the 24 years and over group. Pre-service teachers in the 24 years and over group had a significantly higher mean (M=3.65, SD=0.87) than pre-service teachers in 18-19 years of age group (M=3.27, SD=0.92). This indicates that pre-service teachers in the 24 years and over age group were more confident in their ability to choose appropriate technologies to enhance teaching approaches for a lesson than pre-service teachers in 18-19 years of age group.

For the second item, Post Hoc Tests (Scheffe and Bonferonni) identified a statistically significant difference between pre-service teachers in the 18-19 years of age group and the 24 years and over age group. Pre-service teachers in the 24 years and over age group had a significantly higher mean (M=3.62, SD=0.83) than pre-service teachers in 18-19 years of age group (M=3.29, SD=0.83). This indicates that pre-service teachers in the 24 years and over age group were more confident in their ability to think critically about how to use technology in the classroom than pre-service teachers in 18-19 years of age group.

For the third item, Post Hoc Tests (Scheffe and Bonferonni) identified a statistically significant difference between pre-service teachers in the 18-19 years of age group, the 22-23 years of age group and the 24 years and over group. Pre-service teachers in the 24 years and over age group and the 22-23 years of age group had a significantly higher mean (M=3.55, SD=0.77 and M=3.46, SD=0.81 respectively) than pre-service teachers in the 18-19 years of age group (M=3.02, SD=0.87). This indicates that pre-

service teachers in the 24 years and over age group and the 22-23 years of age group were more confident in their ability to customise the technology they own to different teaching activities than pre-service teachers in 18-19 years of age group.

For the fourth item, Post Hoc Tests (Scheffe and Bonferonni) identified a statistically significant difference between pre-service teachers in the 18-19 years of age group, the 22-23 years of age group and the 24 years and over group. Pre-service teachers in the 24 years and over group and the 22-23 years of age group had a significantly higher mean (M=3.76, SD=0.76 and M=3.68, SD=0.77 respectively) than pre-service teachers in 18-19 years of age group (M=3.37, SD=0.90). This indicates that pre-service teachers in the 24 years and over age group and the 22-23 years of age group were more confident in their ability to select appropriate technologies to use in their classrooms to enhance what they teach than pre-service teachers in 18-19 years of age group.

Technological Content Knowledge (TCK)

ANOVA was conducted to determine whether any statistically significant differences existed based upon pre-service teacher age for these three items. Statistically significant differences (i.e., $p < 0.05$) were identified for all three items:

- *I know how to choose technologies that enhance the development of GNH values in my lessons* ($F(3,633)=4.52$, $p=0.00$).
- *I know how to choose technologies that can enhance the content for a lesson* ($F(3,640)=2.70$, $p=0.045$).
- *I know how to select ICT that enhances what I teach* ($F(3,637)=4.73$, $p=0.00$).

For the first item, Post Hoc Tests (Scheffe and Bonferonni) identified a statistically significant difference between pre-service teachers in the 18-19 years of age group, the 22-23 years of age group and the 24 years and over group. Pre-service teachers in the 24 years and over group and the 22-23 years of age group had a significantly higher mean (M=3.42, SD=0.78 and M=3.44, SD=0.81 respectively) than pre-service teachers in 18-19 years of age group (M=3.05, SD=0.89). This indicates that pre-service teachers in the 24 years and over age group and the 22-23 years of age group were more confident in their ability to choose technologies that enhance the development of GNH values in their lessons than pre-service teachers in 18-19 years of age group.

For the second item, despite a significant ANOVA result, Post Hoc Tests (Scheffe and Bonferonni) failed to identify any statistically significant differences between the age groups. The age variable was then re-coded into three groups: 18-20 years of age; 21-22

years of age; and 23 years and over. Repeating the Post Hoc Tests (Scheffe and Bonferonni) with the re-coded variables indicated there was a statistically significant difference between the recoded 23 years and over group and the re-coded 18-20 years of age group. Pre-service teachers in the 23 years and over age group had a significantly higher mean (M=3.68, SD=0.72) than pre-service teachers in the 18-20 years of age group (M=3.48, SD=0.76). This indicates that pre-service teachers in the 23 years and over age group were more confident in their ability choose technologies that can enhance the content for a lesson than pre-service teachers in the 18-20 years of age group.

For the third item, Post Hoc Tests (Scheffe and Bonferonni) identified a statistically significant difference between pre-service teachers in the 18-19 years of age group, the 20-21 years of age group, the 22-23 years of age group and the 24 years and over age group. Pre-service teachers in the 24 years and over age group, the 22-23 years of age group and the 20-21 years of age group had a significantly higher mean (M=3.76, SD=0.76, M=3.68, SD=0.77 and M=3.58, SD=0.78 respectively) than pre-service teachers in the 18-19 years of age group (M=3.37, SD=0.90). This indicates that pre-service teachers in the 24 years and over age group, the 22-23 years of age group and the 20-21 years of age group were more confident in their ability to select ICT that enhances what they teach than pre-service teachers in the 18-19 years of age group.

Technological Pedagogical Content Knowledge (TPACK)

ANOVA was conducted to determine whether any statistically significant differences existed based upon pre-service teacher age for these four items. A statistically significant difference (i.e., $p < 0.05$) was identified for three items:

- *I know how to use strategies that combine content, technologies and teaching approaches* ($F(3,631)=10.35$, $p=0.00$).
- *I possess adequate skills to provide leadership in helping others to coordinate the use of content, technologies and teaching approaches* ($F(3,634)=3.41$, $p=0.02$).
- *I am able to use strategies that combine content, ICT, and teaching approaches* ($F(3,635)=4.98$, $p=0.00$).

For the first item, Post Hoc Tests (Scheffe and Bonferonni) identified a statistically significant difference between pre-service teachers in the 18-19 years of age group, the 20-21 years of age group, the 22-23 years of age group and the 24 years and over age group. Pre-service teachers in the 24 years and over group, the 22-23 years of age group and the 20-21 years of age group had a significantly higher mean (M=3.60,

SD=0.75, M=3.45, SD=0.79 and M=3.33, SD=0.81 respectively) than pre-service teachers in 18-19 years of age group (M=2.95, SD=0.78). This indicates that pre-service teachers in the 24 years and over age group, the 22-23 years of age group and the 20-21 years of age group were more confident in their ability to use strategies that combine content, technologies and teaching approaches than pre-service teachers in 18-19 years of age group.

For the second item, Post Hoc Tests (Scheffe and Bonferonni) identified a statistically significant difference between pre-service teachers in the 18-19 years of age group and the 24 years and over age group. Pre-service teachers in the 24 years and over age group had a significantly higher mean (M=3.44, SD=0.80) than pre-service teachers in the 18-19 years of age group (M=3.05, SD=0.90). This indicates that pre-service teachers in the 24 years and over age group were more confident in their ability to provide leadership in helping others to coordinate the use of content, technologies and teaching approaches than pre-service teachers in the 18-19 years of age group.

For the third item, Post Hoc Tests (Scheffe and Bonferonni) identified a statistically significant difference between pre-service teachers in the 18-19 years of age group, the 20-21 years of age group, the 22-23 years of age group and the 24 years and over age group. Pre-service teachers in the 24 years and over age group, the 22-23 years of age group and the 20-21 years of age group had a significantly higher mean (M=3.54, SD=0.77, M=3.44, SD=0.81 and M=3.43, SD=0.69 respectively) than pre-service teachers in the 18-19 years of age group (M=3.10, SD=0.80). This indicates that pre-service teachers in the 24 years and over age group, the 22-23 years of age group and the 20-21 years of age group were more confident in their ability to use strategies that combine content, ICT, and teaching approaches than pre-service teachers in the 18-19 years of age group.

5.5.4 Pre-service teacher TPACK according to enrolment programme

One-way ANOVA was conducted to determine whether any statistically significant differences existed for all TPACK items based upon enrolment. The results are presented in Appendix Six (Table A.6.7). A breakdown of the results follows.

Technological Knowledge (TK)

ANOVA was conducted to determine whether any statistically significant differences existed based upon enrolment for these six survey items. Statistically significant differences (i.e., $p < 0.05$) were identified for four items:

- *I know how to solve my own technical problems* (F(2,642)=4.50, p=0.01).
- *I learn technology easily* (F(2,641)=5.88, p=0.00).
- *I know a lot about different technologies* (F(2,637)=4.26, p=0.02).
- *I have the technical skills needed to use technology* (F(2,639)=6.99, p=0.00).

For the first item, Post Hoc Tests (Scheffe and Bonferonni) identified a statistically significant difference between pre-service teachers enrolled in the BEd (Secondary) and the BEd (Primary) and BEd (Dzongkha). Pre-service teachers enrolled in the BEd (Secondary) had a significantly higher mean (M=3.32, SD=0.96) than pre-service teachers enrolled in the BEd(Primary) and BEd (Dzongkha) (M=3.02, SD=0.94 and M=2.99, SD=0.94 respectively). This indicates that pre-service teachers enrolled in BEd (Secondary) were more positive about their ability to solve their own technical problems than pre-service teachers enrolled in the BEd (Primary) and BEd (Dzongkha).

For the second item, Post Hoc Tests (Scheffe and Bonferonni) identified a statistically significant difference between pre-service teachers enrolled in the BEd (Secondary) and the BEd (Dzongkha). Pre-service teachers enrolled in the BEd (Secondary) had a significantly higher mean (M=3.54, SD=0.97) than pre-service teachers enrolled in the BEd (Dzongkha) (M=3.09, SD=0.88). This indicates that pre-service teachers enrolled in BEd (Secondary) were more positive in their ability to learn technology easily than pre-service teachers enrolled in the BEd (Dzongkha).

For the third item, Post Hoc Tests (Scheffe and Bonferonni) identified a statistically significant difference between pre-service teachers enrolled in the BEd (Secondary) and the BEd (Primary). Pre-service teachers enrolled in the BEd (Secondary) had a significantly higher mean (M=3.26, SD=0.91) than pre-service teachers enrolled in the BEd(Primary) (M=2.97, SD=0.88). This indicates that pre-service teachers enrolled in the BEd (Secondary) believed they knew more about different technologies than pre-service teachers enrolled in the BEd (Primary).

For the fourth item, Post Hoc Tests (Scheffe and Bonferonni) identified a statistically significant difference between pre-service teachers enrolled in the BEd(Secondary) and those enrolled in the BEd (Primary) and BEd (Dzongkha). Pre-service teachers enrolled in the BEd (Secondary) had a significantly higher mean (M=3.50, SD=0.87) than pre-service teachers enrolled in the BEd (Primary) and BEd (Dzongkha) (M=3.15, SD=0.85 and M=3.11, SD=0.97 respectively). This indicates that pre-service teachers enrolled in BEd(Secondary) were more positive that they have the technical skills needed to use

technology than pre-service teachers enrolled in the BEd (Primary) and BEd (Dzongkha).

Technological Pedagogical Knowledge (TPK)

ANOVA was conducted to determine whether any statistically significant differences existed based upon pre-service teacher enrolment for these five survey items. A statistically significant difference (i.e., $p < 0.05$) was identified for one item:

- *I am confident to customise the technology that I own to different teaching activities* ($F=4.35$, $p=0.01$).

For this item, Post Hoc Tests (Scheffe and Bonferonni) identified a statistically significant difference between pre-service teachers enrolled in the BEd (Secondary) and the BEd (Primary). Pre-service teachers enrolled in the BEd (Secondary) had a significantly higher mean ($M=3.61$, $SD=0.78$) than pre-service teachers enrolled in the BEd (Primary) ($M=3.34$, $SD=0.82$). This indicates that pre-service teachers enrolled in BEd (Secondary) were more confident to customise the technology that they own to different teaching activities than pre-service teachers enrolled in the BEd (Primary).

Technological Content Knowledge (TCK)

ANOVA was conducted to determine whether any statistically significant differences existed based upon pre-service teacher enrolment for these three survey items. Statistically significant differences (i.e., $p < 0.05$) were identified for two items:

- *I know how to choose technologies that enhance the development of GNH values in my lessons* ($F(2,636)=3.62$, $p=0.027$).
- *I know how to choose technologies that can enhance the content for a lesson* ($F(2,643)=4.99$, $p=0.01$).

For the first item, despite a significant ANOVA result, Post Hoc Tests (Scheffe and Bonferonni) failed to identify any statistically significant differences for this item.

For the second item, Post Hoc Tests (Scheffe and Bonferonni) identified a statistically significant difference between pre-service teachers enrolled in the BEd(Secondary) and the BEd(Primary). Pre-service teachers enrolled in the BEd(Secondary) had a significantly higher mean ($M=3.84$, $SD=0.72$) than pre-service teachers enrolled in the BEd(Primary) ($M=3.57$, $SD=0.74$). This indicates that pre-service teachers enrolled in BEd(Secondary) were more confident to choose technologies that can enhance the content for a lesson than pre-service teachers enrolled in the BEd(Primary).

Technological Pedagogical Content Knowledge (TPACK)

ANOVA was conducted to determine whether any statistically significant differences existed based upon pre-service teacher enrolment for these four survey items. A statistically significant difference (i.e., $p < 0.05$) was identified for one item:

- *I possess adequate skills to provide leadership in helping others to coordinate the use of content, technologies and teaching approaches* ($F(2,637)=6.75$, $p=0.001$).

For this item, Post Hoc Tests (Scheffe and Bonferonni) identified a statistically significant difference between pre-service teachers enrolled in the BEd (Secondary) and the BEd(Primary). Pre-service teachers enrolled in the BEd (Secondary) had a significantly higher mean ($M=3.62$, $SD=0.75$) than pre-service teachers enrolled in the BEd(Primary) ($M=3.28$, $SD=0.85$). This indicates that pre-service teachers enrolled in BEd(Secondary) were more confident to provide leadership in helping others to coordinate the use of content, technologies and teaching approaches than pre-service teachers enrolled in the BEd(Primary).

5.5.5 Pre-service teacher TPACK according to year of study

The results are presented in Appendix Six (Table A.6.8). A breakdown of the results follows.

Technological Knowledge (TK)

ANOVA was conducted to determine whether any statistically significant differences existed based upon pre-service teacher age for these five survey items. Statistically significant differences (i.e., $p < 0.05$) were identified for all six items:

- *I know how to solve my own technical problems* ($F(3,633)=8.31$, $p=0.00$).
- *I learn new technology easily* ($F(3,632)=4.20$, $p=0.01$).
- *I keep up with new technologies* ($F(3,631)=6.16$, $p=0.00$).
- *I frequently play around with the technology* ($F(3,633)=4.45$, $p=0.00$).
- *I know a lot about different technologies* ($F(3,629)=4.95$, $p=0.00$).
- *I have the technical skills needed to use technology* ($F(3,630)=5.46$, $p=0.00$).

For the first item, Post Hoc Tests (Scheffe and Bonferonni) identified statistically significant differences between First Year pre-service teachers and Third and Fourth Year pre-service teachers. Pre-service teachers enrolled in Fourth Year and Third Year group had a significantly higher mean ($M=3.36$, $SD=0.77$ and $M=3.14$, $SD=0.86$ respectively) than First Year pre-service teachers ($M=2.83$, $SD=1.04$). A further

statistically significant difference was identified between Fourth Year and Second Year pre-service teachers. Fourth Year pre-service teachers had a significantly higher mean (M=3.36, SD=0.77) than Second Year pre-service teachers (M=3.05, SD=0.95). This indicates that Third Year pre-service teachers were more positive in their ability to solve their own technical problems than First Year pre-service teachers and Fourth Year pre-service teachers were more confident than both First Year and Second Year pre-service teachers.

For the second item, Post Hoc Tests (Scheffe and Bonferonni) identified a statistically significant difference between First Year and Fourth Year pre-service teachers. Fourth Year pre-service teachers had a significantly higher mean (M=3.52, SD=0.83) than First Year pre-service teachers (M=3.19, SD=0.92). This indicates that Fourth Year pre-service teachers were more positive in their ability to learn technology easily than First Year pre-service teachers.

For the third item, Post Hoc Tests (Scheffe and Bonferonni) identified statistically significant differences between First Year pre-service teachers and Third and Fourth Year pre-service teachers. Pre-service teachers enrolled in Fourth Year and Third Year group had significantly higher means (M=3.46, SD=0.84 and M=3.68, SD=0.77 respectively) than First Year pre-service teachers (M=2.28, SD=0.93). This indicates that both Fourth and Third Year pre-service teachers were more positive in their ability to keep up with new technologies than First Year pre-service teachers.

For the fourth item, Post Hoc Tests (Scheffe and Bonferonni) identified a statistically significant difference between First Year pre-service teachers and Third and Fourth Year pre-service teachers. Pre-service teachers enrolled in Fourth Year and Third Year group had significantly higher means (M=3.76, SD=0.82 and M=3.91, SD=0.71 respectively) than First Year pre-service teachers (M=3.59, SD=0.92). This indicates that Fourth and Third Year pre-service teachers were more likely to frequently play around with new technology than First Year pre-service teachers.

For the fifth item, Post Hoc Tests (Scheffe and Bonferonni) identified a statistically significant difference between First Year pre-service teachers and Third and Fourth Year pre-service teachers. Pre-service teachers enrolled in the Fourth Year and Third Year group had significantly higher means (M=3.18, SD=0.85 and M=3.17, SD=0.83 respectively) than First Year pre-service teachers (M=2.85, SD=0.91). This indicates that Fourth and Third Year pre-service teachers were more positive in their belief that they know more about different technologies than First Year pre-service teachers.

For the sixth item, Post Hoc Tests (Scheffe and Bonferonni) identified a statistically significant difference between First Year pre-service teachers and Third and Fourth Year pre-service teachers. Pre-service teachers enrolled in Fourth Year and Third Year group had significantly higher means (M=3.35, SD=0.84 and M=3.36, SD=0.79 respectively) than First Year pre-service teachers (M=3.03, SD=0.90). This indicates that Fourth and Third Year pre-service teachers were more positive in their belief that they have the technical skills needed to use technology than First Year pre-service teachers.

Technological Pedagogical Knowledge (TPK)

Statistically significant differences (i.e., $p < 0.05$) were identified for all five items in this category:

- *I know how to choose technologies that enhance students' learning for a lesson* (F(3,628)=4.13, p=0.01).
- *I know how choose appropriate technologies to enhance teaching approaches for a lesson (F(3,632)=15.57, p=0.00).*
- *I can think critically about how to use technology in the (F(3,631)=6.06, p=0.00)*
- *I am confident to customise the technology that I own to different teaching activities* (F(3,629)=9.74, p=0.00).
- *I am able to select appropriate technologies to use in my classroom to enhance what I teach* (F(3,629)=8.86, p=0.00).

For the first item, Post Hoc Tests (Scheffe and Bonferonni) identified a statistically significant difference between First Year and Fourth Year pre-service teachers. Fourth Year pre-service teachers had a significantly higher mean (M=3.77, SD=0.62) than First Year pre-service teachers (M=3.48, SD=0.78). This indicates that Fourth Year pre-service teachers were more confident to choose appropriate technologies that enhance pre-service teachers' learning for a lesson than First Year pre-service teachers.

For the second item, Post Hoc Tests (Scheffe and Bonferonni) identified statistically significant differences between First Year pre-service teachers and Second, Third and Fourth Year pre-service teachers. Pre-service teachers enrolled in Fourth, Third and Second Year groups had significantly higher means (M=3.76, SD=0.68, M=3.68, SD=0.76 and M=3.49, SD=0.86 respectively) than First Year pre-service teachers (M=3.19, SD=0.89). A further statistically significant difference was identified between Fourth Year and Second Year pre-service teachers. The mean of Fourth Year pre-service teachers was significantly higher than Second Year pre-service teachers. This indicates that Fourth Year, Third Year and Second Year pre-service teachers were more

confident to choose appropriate technologies that enhance teaching approaches for a lesson than First Year pre-service teachers. Also, Fourth Year pre-service teachers were more confident than Second Year pre-service teachers.

For the third item, Post Hoc Tests (Scheffe and Bonferonni) identified statistically significant differences between First Year pre-service teachers and Second, Third and Fourth Year pre-service teachers. Pre-service teachers enrolled in Fourth, Third and Second Year groups had significantly higher means (M=3.72, SD=0.68, M=3.59, SD=0.80 and M=3.59, SD=0.79 respectively) than First Year pre-service teachers (M=3.35, SD=0.88). This indicates that Fourth Year, Third Year and Second Year pre-service teachers were more confident that they can think critically about how to use technology in the classroom than First Year pre-service teachers.

For the fourth item, Post Hoc Tests (Scheffe and Bonferonni) identified statistically significant differences between First Year pre-service teachers and Second, Third and Fourth Year pre-service teachers. Pre-service teachers enrolled in Fourth, Third and Second Year groups had significantly higher means (M=3.57, SD=0.76, M=3.54, SD=0.68 and M=3.41, SD=0.82 respectively) than First Year pre-service teachers (M=3.14, SD=0.91). This indicates that Fourth Year, Third Year and Second Year pre-service teachers were more confident that they can customise technology to different teaching activities than First Year pre-service teachers.

For the fifth item, Post Hoc Tests (Scheffe and Bonferonni) identified statistically significant differences between First Year pre-service teachers and Third and Fourth Year pre-service teachers. Pre-service teachers enrolled in Fourth and Third Year groups had significantly higher means (M=3.88, SD=0.67 and M=3.73, SD=0.70 respectively) than First Year pre-service teachers (M=3.43, SD=0.89). A further statistically significant difference was identified between Fourth Year and Second Year pre-service teachers. The mean of Fourth Year pre-service teachers was significantly higher than Second Year pre-service teachers (M=3.41, SD=0.82). This indicates that Fourth Year and Third Year pre-service teachers were more confident to select appropriate technologies to enhance what they teach than First Year pre-service teachers. Also, Fourth Year pre-service teachers were more confident than Second Year pre-service teachers for this item.

Technological Content Knowledge (TCK)

Statistically significant differences (i.e., $p < 0.05$) were identified for all three items:

- *I know how to choose technologies that enhance the development of GNH values in my lessons* (*F(3,627)=2.65, p=0.048).*
- *I know how to choose technologies that can enhance the content for a lesson* (F(3,634)=8.91, p=0.00).
- *I know how to select ICT that enhances what I teach* (F(3,631)=11.29, p=0.00).

For the first item, Post Hoc Tests (Scheffe and Bonferonni) identified a statistically significant difference between First Year and Third Year pre-service teachers. Third Year pre-service teachers had a significantly higher mean (M=3.50, SD=0.76) than First Year pre-service teachers (M=3.25, SD=0.89). This indicates that Third Year pre-service teachers were more confident to choose technologies that enhance the development of GNH values in their lessons than First Year pre-service teachers.

For the second item, Post Hoc Tests (Scheffe and Bonferonni) identified statistically significant differences between First Year pre-service teachers and Third and Fourth Year pre-service teachers. Pre-service teachers enrolled in Fourth and Third Year groups had significantly higher means (M=3.83, SD=0.58 and M=3.76, SD=0.64 respectively) than First Year pre-service teachers (M=3.43, SD=0.85). A further statistically significant difference was identified between Fourth Year and Second Year pre-service teachers. The mean of Fourth Year pre-service teachers was significantly higher than Second Year pre-service teachers (M=3.58, SD=0.78). This indicates that Fourth Year and Third Year pre-service teachers were more confident to choose technologies that can enhance content for a lesson than First Year pre-service teachers. Also, Fourth Year pre-service teachers were more confident than Second Year pre-service teachers.

For the third item, Post Hoc Tests (Scheffe and Bonferonni) identified statistically significant differences between First Year pre-service teachers and Second, Third and Fourth Year pre-service teachers. Pre-service teachers enrolled in Fourth, Third and Second Year groups had significantly higher means (M=3.83, SD=0.58, M=3.76, SD=0.64 and M=3.60, SD=0.77 respectively) than First Year pre-service teachers (M=3.35, SD=0.84). This indicates that Fourth Year, Third Year and Second Year pre-service teachers were more confident to select ICT that enhances what they teach than First Year pre-service teachers.

Technological Pedagogical Content Knowledge (TPACK)

Statistically significant differences (i.e., $p < 0.05$) were identified for all four items:

- *I know how to use strategies that combine content, technologies and teaching approaches* (F(3,625)=22.01, p=0.00).
- *I possess adequate skills to provide leadership in helping others to coordinate the use of content, technologies and teaching approaches* (F(3,628)=3.79, p=0.01).
- *I am able use strategies that combine content, technologies and teaching approaches* (F(3,629)=9.49, p=0.00).
- *I can appropriately combine content, ICT, and teaching approaches in a classroom lesson* (F(3,626)=6.12, p=0.00).

For the first item, Post Hoc Tests (Scheffe and Bonferonni) identified statistically significant differences between First Year pre-service teachers and Second, Third and Fourth Year pre-service teachers. Pre-service teachers enrolled in Fourth, Third and Second Year groups had significantly higher means (M=3.67, SD=0.66, M=3.61, SD=0.67 and M=3.43, SD=0.85 respectively) than First Year pre-service teachers (M=3.05, SD=0.81). A further statistically significant difference was identified between Fourth Year and Second Year pre-service teachers. The mean of Fourth Year pre-service teachers was significantly higher than Second Year pre-service teachers. This indicates that Fourth Year, Third Year and Second Year pre-service teachers were more confident to use strategies that combine content, technologies and teaching approaches than First Year pre-service teachers. Also, Fourth Year pre-service teachers were more confident than Second Year pre-service teachers.

For the second item, Post Hoc Tests (Scheffe and Bonferonni) identified statistically significant differences between First Year pre-service teachers and Third and Fourth Year pre-service teachers. Pre-service teachers enrolled in Fourth and Third Year groups had significantly higher means (M=3.47, SD=0.71 and M=3.44, SD=0.78 respectively) than First Year pre-service teachers (M=3.19, SD=0.91). This indicates that Fourth Year and Third Year pre-service teachers were more confident to provide leadership in helping others to coordinate the use of content, technologies and teaching approaches than First Year pre-service teachers.

For the third item, Post Hoc Tests (Scheffe and Bonferonni) identified statistically significant differences between First Year pre-service teachers and Second, Third and Fourth Year pre-service teachers. Pre-service teachers enrolled in Fourth, Third and Second Year groups had significantly higher means (M=3.66, SD=0.65, M=3.45, SD=0.74 and M=3.48, SD=0.76 respectively) than First Year pre-service teachers (M=3.21, SD=0.81). This indicates that Fourth Year, Third Year and Second Year pre-

service teachers were more confident to use strategies that combine content, ICT, and teaching approaches than First Year pre-service teachers.

For the fourth item, Post Hoc Tests (Scheffe and Bonferonni) identified statistically significant differences between First Year pre-service teachers and Second, Third and Fourth Year pre-service teachers. Pre-service teachers enrolled in Fourth, Third and Second Year groups had significantly higher means (M=4.55, SD=0.83, M=4.42, SD=0.98 and M=4.43, SD=1.04 respectively) than First Year pre-service teachers (M=4.08, SD=1.24). This indicates that Fourth Year, Third Year and Second Year pre-service teachers were more confident to appropriately combine content, ICT, and teaching approaches in a classroom lesson than First Year pre-service teachers.

5.6 INTERNAL RELIABILITY

Internal reliability is the measure of the internal consistency of a set of scale items (Cooksey, 2007). The most frequently used measure of internal reliability is Cronbach's Alpha. Cronbach's Alpha reliability ranges between 0 to 1. Acceptable values of Cronbach's Alpha are considered to be in the 0.6 to 0.8 range (Cooksey, 2007).

The values of Cronbach's Alpha for the relevant survey categories are presented in Table 5.11.

Table 5.11. Cronbach's Alpha for survey categories items

Scale Items	**Cronbach's Alpha**
Attitudes towards GNH and GNH in education	0.51
Attitudes towards ICT in education	0.85
Attitudes towards ICT enhancing GNH principles and values	0.90
Technological Knowledge (TK)	0.85
Technological Pedagogical Knowledge (TPK)	0.87
Technological Content Knowledge (TCK)	0.79
Technological Pedagogical Content Knowledge (TPCK)	0.84

Except for *Attitudes towards GNH and GNH in Education*, all scale categories were within an acceptable range of Cronbach's Alpha suggesting an acceptable level of internal reliability for these survey items. Further analysis indicated that internal reliability of this category could be improved from 0.51 to 0.61 by the removal of the scale item - *I believe I possess adequate knowledge about GNH principles and values* - from this category. There however, was an acceptable level of internal reliability for the corresponding category in the lecturer survey results (0.72 - see Table 6.12). This suggests that pre-

service teachers' conceptions of the survey items in this category were not the same as lecturers. Despite a relatively low Cronbach Alpha, the decision was made not to remove this item from the analysis. However, caution must be taken when considering results from this survey category.

5.7 CHAPTER CONCLUSION

This chapter presented the results of the pre-service teacher web-based survey. In general, pre-service teachers had positive attitudes towards GNH and GNH in education and positive attitudes towards ICT in Education and ICT enhancing GNH principles and values. Despite these positive attitudes, pre-service teachers perceived themselves as having only some TPACK. Marked sex differences were identified for all TPACK items with male pre-service teachers ranking themselves higher than female pre-service teachers. Two generalizations could be made from the TPACK results. First, in relation to age and year of study, typically TPACK and related components (TK, TPK and TCK) progressively increased with age and year of study. Second, in relation to enrolment programme, pre-service teachers enrolled in the BEd(Secondary) consistently rated themselves higher for a number of TPACK items than the ratings the pre-service teachers enrolled in the BEd(Primary) gave themselves.

The next chapter (Chapter Six) presents the results of the lecturer web-based survey. Chapter Six follows the same structure as this chapter except for a comparison of pre-service teacher and lecturer web-based survey results concluding the chapter.

CHAPTER SIX

LECTURER SURVEY RESULTS

This chapter presents the results for the lecturer web-based survey, and is divided into eight sections. The first section provides the demographic data of the lecturers who took part in the survey. The second section presents the results for the survey items focusing on attitudes towards GNH and GNH in education. The third section presents the results for the survey items on attitudes towards ICT in education. The fourth section presents the results of the survey items dealing with attitudes towards ICT enhancing GNH principle and values. The fifth section examines the results of the survey items used to assess lecturer Technological Pedagogical and Content Knowledge (TPACK). The sixth section examines the internal reliability of the web-based survey items. The seventh section provides a comparison of pre-service teacher and lecturer web-based survey results. The eighth proivdes a conclusion to the chapter.

6.1 LECTURER DEMOGRAPHICS

This section provides background information about the lecturers who participated in the survey. In particular, survey response rates, and age, sex, and teaching experience of the respondents.

6.1.1 Response rates

The response rates for the lecturer survey are presented in Table 6.1 The total response rate for lecturers was 51%. While response rates are lower for online surveys than paper-based surveys, a response rate of 50% or higher for online surveys is generally considered acceptable (Nulty, 2008).

Table 6.1. Response rates

Sample	Potential Sample (n)	Respondents (n)	Response Rate (%)
Male Lecturers	43	18	42
Female Lecturers	8	8	100
Total	51	26	51

6.1.2 Lecturer age and sex

The age and sex of lecturer respondents is presented in Table 6.2. More than half the male lecturers (n=11) were in the 36 to 45 years age bracket. The most common age for female lecturers was 36 to 40 years of age. The age profiles of the lecturer respondents were considered to approximate the age profile of the lecturers at the college.

Table 6.2. Lecturer age and sex

Age (Years)	**Male (n)**	**Female (n)**	**Total (n)**
25 or less	0	0	0
26-30	3	0	3
31-35	1	2	3
36-40	5	5	10
41-45	6	0	6
46-50	3	1	4
51 and over	0	0	0
Total	18	8	26

6.1.3 Lecturer teaching experience

The lecturer teaching experience is presented in Table 6.3. The majority of the lecturers at the college (n=16) had teaching experience between 11 and 20 years.

Table 6.3. Lecturer teaching experience

Experience (Years)	**Male (n)**	**Female (n)**	**Total (n)**
5 or less	2	0	2
5-10	3	2	5
11-15	3	3	6
16-20	8	2	10
21-25	2	0	2
26-30	0	1	1
31 and over	0	0	0
Total	18	8	26

6.1.4 Summary

Despite the relatively lower response rates for male respondents (42%) compared to female respondents (100%), the total response rate (51%) for the sample was considered acceptable. Overall, the age, sex, and teaching experience of respondents were considered to reasonably approximate that of the profile of lecturers at the

college. Thus, the study sample used was considered to be a representative sample of the study population.

6.2 LECTURER ATTITUDES TOWARDS GNH AND GNH IN EDUCATION

Three survey items asked lecturers to assess pre-service teachers' attitudes towards GNH and GNH in education using a five point Likert scale: 1. Strongly disagree (SD), 2. Disagree (D), 3. Neither agree nor disagree (NAD), 4. Agree (A), 5. Strongly agree (SA). As the survey was to be completed my lecturers, the term *student(s)* was used in the survey items to refer to the pre-service teachers because lecturers at the college usually refered to the pre-service teachers as students. For brevity, the term *student(s)* appears when items are reproduced in tables in this chapter, but in the text of the analysis write-up only the term pre-service teachers is used. As for Chapter Five standard deviation has been abbreviated to S.D. in the statistical tables.

6.2.1 Frequency Analysis

Frequencies of responses to these three survey items are presented in Table 6.4.

Table 6.4. Attitudes towards GNH and GNH in education

Item	SD	D	NAD	A	SA	Mean	S.D.
I am confident my students possess adequate knowledge about GNH principles and values	3 (11.5%)	6 (23.1%)	7 (26.9%)	10 (38.5%)	0 (0%)	2.9	1.06
I am confident my students believe GNH should be infused into my day-to-day teaching	1 (3.8%)	2 (7.7%)	6 (23.1%)	15 (57.7%)	2 (7.7%)	3.6	0.90
I am confident my students believe it is necessary for the pre-service teacher curriculum in Bhutan to reflect GNH	1 (3.8%)	2 (7.7%)	4 (15.4%)	17 (65.4%)	2 (7.7%)	3.7	0.89

Note: SD - Strongly disagree; D - Disagree; NAD - Neither agree or disagree; A - Agree; SA - Strongly agree

The survey results show that only a minority of lecturers believed that pre-service teachers have an adequate knowledge of GNH principles and values, with nearly 50% (n=26) of lecturers either disagreeing (23.1%) or strongly disagreeing (11.5%) that they were confident that pre-service teachers possessed adequate knowledge of GNH principles and values. Furthermore, more than 26.9% of lecturers were unsure whether pre-service teachers possessed adequate knowledge of GNH principles and values. More encouragingly, 65.4% of lecturers either agreed or strongly agreed that they were confident that pre-service teachers believed GNH should be infused into day-to-day

teaching. Of a similar magnitude, 73.1% of lecturers either agreed or strongly agreed that pre-service teachers believed it necessary for the pre-service teacher curriculum in Bhutan to reflect GNH.

6.2.2 Lecturer perceptions according to sex

Independent t-tests were conducted to determine whether any statistically significant differences existed between male and female lecturers' perceptions of pre-service teachers for these three survey items. The complete results are presented in Appendix Seven (Table A.7.1). No statistically significant differences (i.e., $p < 0.05$) were identified between male and female lecturer responses for these three items indicating that male and female lecturers held similar perceptions about pre-service teachers' attitudes towards GNH and GNH in education.

6.2.3 Lecturer perceptions according to age

ANOVA was conducted to determine whether any statistically significant differences existed for lecturer perceptions of pre-service teachers based upon lecturer age for these three survey items. Full results are presented in Appendix Seven (Table A.7.2). No statistically significant differences (i.e., $p < 0.05$) were identified for these three items indicating that the age of lecturers did not influence their perceptions about pre-service teachers' attitudes towards GNH and GNH in education.

6.2.4 Lecturer perceptions according to teaching experience

ANOVA was conducted to determine whether any statistically significant differences existed for lecturer perceptions based upon lecturer teaching experience for these three survey items. Full results are presented in Appendix Seven (Table A.7.3). No statistically significant differences (i.e., $p < 0.05$) were identified for these three items indicating that the teaching experience of lecturers did not influence their perceptions about pre-service teachers' attitudes towards GNH and GNH in education.

6.3 LECTURER ATTITUDES TOWARDS ICT IN EDUCATION

Ten survey items asked lecturers to assess pre-service teachers' attitudes towards ICT in education using a five point Likert scale: 1. Strongly disagree (SD), 2. Disagree (D), 3. Neither agree nor disagree (NAD), 4. Agree (A), 5. Strongly agree (SA).

6.3.1 Frequency Analysis

Frequencies of responses to these ten survey items are presented in Table 6.5.

Table 6.5. Attitudes towards ICT in education

Item	SD	D	NAD	A	SA	Mean	S.D.
I am confident my students believe ICT tools can make my teaching and learning more effective	0 (0%)	0 (0%)	0 (0%)	14 (56%)	11 (44%)	4.4	0.51
I am confident my students believe the use of ICT tools make learning activities more efficient	0 (0%)	0 (0%)	0 (0%)	14 (56%)	11 (44%)	4.4	0.51
I am confident my students believe ICT enhances the way they learn	0 (0%)	0 (0%)	1 (3.8%)	18 (69.2%)	7 (26.9)%	4.2	0.51
I am confident my students believe ICT is an effective tool to create conducive learning environments for learners	0 (0%)	0 (0%)	8 (30.8%)	16 (61.5%)	2 (7.7%)	3.8	0.59
I am confident my students believe ICT is a good tool to engage students	0 (0%)	0 (0%)	0 (0%)	19 (73.1)	7 (26.9%)	4.3	0.45
I am confident my students believe ICT can make learning more efficient	0 (0%)	0 (0%)	2 (8%)	17 (68%)	6 (24%)	4.2	0.55
I am confident my students believe ICT can improve the quality of education	0 (0%)	0 (0%)	4 (15.4%)	19 (73.1%)	3 (11.5%)	4.0	0.53
I am confident my students believe ICT can improve the academic performance of learners	0 (0%)	0 (0%)	6 (23.1%)	16 (61.5%)	4 (15.4%)	3.9	0.63
I am confident my students believe using ICT has the potential to improve one's ability to teach	0 (0%)	0 (0%)	3 (11.5%)	18 (69.2%)	5 (19.2%)	4.1	0.56
I am confident my students believe it is possible to change learning from passive to active using ICT tools	0 (0%)	0 (0%)	2 (7.7%)	21 (80.8%)	3 (11.5%)	4.0	0.45

Note: SD - Strongly disagree; D - Disagree; NAD - Neither agree or disagree; A - Agree; SA - Strongly agree

Lecturers' perceptions of pre-service teacher attitudes towards ICT in education were positive with the majority of lecturers either agreeing or strongly agreeing for all survey items in this category. However, for one item, *I am confident my students believe ICT is an effective tool to create conducive learning environments for learners,* the results showed that 30.8% of the lecturers remained undecided. Similarly, for the item, *I am confident my students believe ICT can improve the academic performance of learners*, 23.1% of lecturers remained undecided.

6.3.2 Lecturer perceptions according to sex

Independent t-tests were conducted to determine whether any statistically significant differences existed between male and female lecturers' perceptions of pre-service teacher attitudes towards ICT in education for these ten survey items. The complete results are presented in Appendix Seven (Table A.7.1). No statistically significant difference (i.e., $p < 0.05$) were identified between male and female lecturer responses for these ten items indicating that male and female lecturers held similar perceptions about pre-service teachers' attitudes towards ICT in education.

6.3.3 Lecturer perceptions according to age

ANOVA was conducted to determine whether any statistically significant differences existed for lecturer perceptions of pre-service teacher attitudes to ICT in eductaion based upon lecturer age for these ten survey items. Full results are presented in Appendix Seven (Table A.7.2). A statistically significant difference (i.e., $p < 0.05$) was identified for one item:

I am confident my students believe ICT can make learning more efficient ($F(4,20)=3.21$, $p=0.04$).

However, despite a significant ANOVA result, Post Hoc Tests (Scheffe and Bonferonni) failed to identify any statistically significant differences between the age groups for this item. The age variable was then re-coded into three groups: 26-35 years of age; 36-40 years of age; and 41 and over. Repeating the Post Hoc Tests (Scheffe and Bonferonni) with the re-coded variables identified a statistically significant difference between 26-35 years of age and 36-40 years of age groups. The mean score of the 26-35 years of age group ($M=4.67$, $SD=0.52$) was significantly higher ($p=0.05$) than the mean score of the 36-40 years of age group ($M=3.80$, $SD=0.42$). Lecturers in the 26-35 years of age group were more confident than lecturers in the 36-40 years of age group that the preservice teachers believe ICT can make learning more efficient.

6.3.4 Lecturer perceptions according to teaching experience

ANOVA was conducted to determine whether any statistically significant differences existed for lecturer perceptions of pre-service teacher attitudes towards ICT in education based upon lecturer teaching experience for these ten survey items. Full results are presented in Appendix Seven (Table A.7.3). No statistically significant differences (i.e., $p < 0.05$) were identified for these ten items indicating that the teaching

experience of lecturers did not influence their perceptions about pre-service teachers' attitudes towards ICT in education.

6.4 LECTURER ATTITUDES TOWARDS ICT ENHANCING GNH PRINCIPLES AND VALUES

Seventeen survey items asked lecturers to assess pre-service teachers' attitudes towards ICT enhancing GNH principles and values using a five point Likert scale: 1. Strongly disagree (SD), 2. Disagree (D), 3. Neither agree nor disagree (NAD), 4. Agree (A), 5. Strongly agree (SA).

6.4.1 Frequency Analysis

Frequencies of the responses to these seventeen items are presented in Table 6.6.

Table 6.6. Attitudes towards ICT enhancing GNH principles and values

Item	SD	D	NAD	A	SA	Mean	S.D.
I am confident my students believe ICT has the potential to make them more imaginative students	0 (0%)	1 (3.8%)	5 (19.2%)	14 (53.8%)	6 (23.1%)	4.0	0.77
I am confident my students believe ICT tools can help enhance creativity	0 (0%)	1 (3.8%)	3 (11.5%)	11 (42.3%)	11 (42.3%)	4.2	0.82
I am confident my students believe ICT tools have the potential to effectively internalise GNH values	0 (0%)	3 (11.5%)	11 (42.3%)	10 (38.5%)	2 (7.7%)	3.4	0.81
I am confident my students believe ICT can be an effective tool to foster GNH to better become part of their lives	0 (0%)	3 (12%)	9 (36%)	11 (44%)	2 (8%)	3.5	0.82
I am confident my students believe ICT tools can make learning more enjoyable	0 (0%)	0 (0%)	0 (0%)	13 (50%)	13 (15%)	4.5	0.51
I am confident my students believe ICT tools can make learning more relevant	0 (0%)	1 (3.8%)	2 (7.7%)	15 (57.7%)	8 (30.8%)	4.2	0.73
I am confident my students believe GNH values are enhanced more efficiently using ICT tools	0 (0%)	2 (8.3%)	10 (41.7%)	11 (45.8%)	1 (4.2%)	3.5	0.72
I am confident my students believe ICT is an efficient tool to enhance GNH values such as integrity	0 (0%)	2 (7.7%	12 (46.2%)	11 (42.3%)	1 (3.8%)	3.4	0.70
I am confident my students believe ICT is an efficient tool to enhance their motivation to learn	0 (0%)	0 (0%)	1 (3.8%)	19 (76%)	5 (20%)	4.2	0.47

Item	SD	D	NAD	A	SA	Mean	S.D.
I am confident my students believe ICT is an efficient tool to enhance GNH values such as integrity	0 (0%)	2 (7.7%	12 (46.2%)	11 (42.3%)	1 (3.8%)	3.4	0.70
I am confident my students believe ICT is an efficient tool to enhance their motivation to learn	0 (0%)	0 (0%)	1 (3.8%)	19 (76%)	5 (20%)	4.2	0.47
I am confident my students believe the use of ICT tools aid in enhancing critical thinking skills	0 (0%)	1 (3.8%)	4 (15.4%)	15 (57.7%)	6 (23.1%)	4.0	0.75
I am confident my students believe that using ICT tools enhance student ability to collaborate efficiently	0 (0%)	0 (0%)	7 (28%)	11 (44%)	7 (28%)	4.0	0.76
I am confident my students believe ICT tools possess the potential to make learners become more reflective	0 (0%)	1 (4%)	6 (24%)	15 (60%)	3 (12%)	3.8	0.71
I am confident my students believe ICT is a good tool to help one become more mindful about what one does	1 (4%)	2 (8%)	9 (36%)	11 (44%)	2 (8%)	3.4	0.92
I am confident my students believe ICT is an effective tool to learn about media literacy	0 (0%)	0 (0%)	2 (8%)	16 (64%)	7 (28%)	4.2	0.58
I am confident my students believe ICT has the potential to create lifelong learners	0 (0%)	0 (0%)	6 (23.1%)	13 (50%)	7 (26.9%)	4.0	0.72
I am confident my students believe using ICT tools can improve student emotional well-being	0 (0%)	2 (7.7%)	10 (38.5%)	13 (50%)	1 (3.8%)	3.5	0.71
I am confident my students believe using ICT can empower a learner	0 (0%)	0 (0%)	4 (15.4%)	15 (57.7%)	7 (26.9%)	4.1	0.65

Note: SD - Strongly disagree; D - Disagree; NAD - Neither agree or disagree; A - Agree; SA - Strongly agree

Results suggest that lecturers were not as confident in their responses about pre-service teacher attitudes towards ICT enhancing GNH principles and values as they were for assessing pre-service teacher attitudes towards ICT in education (see Table 6.5). Despite a range of positive responses (i.e., agree or strongly agree) for the statements presented, for six of the items in this category there were relatively large responses of *neither agree nor disagree*. These items were:

- *I am confident my students believe ICT tools have the potential to effectively internalise GNH values* (42.3%).
- *I am confident my students believe ICT can be an effective tool to foster GNH to better become part of their lives* (36%).

- *I am confident my students believe GNH values are enhanced more efficiently using ICT tools* (41.7%).
- *I am confident my students believe ICT is an efficient tool to enhance GNH values such as integrity* (46.2%).
- *I am confident my students believe ICT is a good tool to help one become more mindful about what one does* (36%).
- *I am confident my students believe using ICT tools can improve a student's emotional well-being* (38.5%).

While no obvious patterns can be discerned for these items, two observations can be made. First, a number of the statements describe GNH in generic terms; for example, *GNH values* in contrast to *critical thinking skills.* This suggests that lecturers may have felt more confident in assessing specific GNH principles and values rather than GNH principles and values as a whole. Second, out of these specific GNH principles and values, lecturers were less confident in assessing constructs such as, *integrity*, *mindfulness*, and *well-being*. These are possibly less well-known constructs in contrast to *motivation*, *media literacy*, and *critical thinking skills*, all of which should be familiar to education lecturers.

6.4.2 Lecturer perceptions according to sex

Independent t-tests were conducted to determine whether any statistically significant differences existed between male and female lecturers' perceptions of pre-service teachers' attitudes towards ICT enhancing GNH principles and values for these 17 survey items. The complete results are presented in Appendix Seven (Table A.7.1). Statistically significant differences (i.e., $p < 0.05$) were identified between male and female lecturer responses for four items:

- *I am confident my students believe ICT tools have the potential to effectively internalise GNH* values - Males (M=3.67, SD =0.77), Females (M=2.88, SD =0.64), t(24)=2.54, p= 0.02.
- *I am confident my students believe ICT can be an effective tool to foster GNH to better become part of their lives* - Males (M=3.71, SD =0.77), Females (M=3.00, SD =0.76), t(24)=2.15, p=0.04.
- *I am confident my students believe ICT tools possess the potential to make learners become more reflective* - Males (M=4.00, SD =0.71), Females (M=3.38, SD =0.52), t(24)= 2.23, p=0.04.

- *I am confident my students believe ICT has the potential to create lifelong learners* - Males (M=4.22, SD =0.65), Females (M=3.63, SD =0.75), t(24)=2.08, p=0.05.

For all of the identified statistically significant responses male lecturers had a higher overall mean than female lecturers. This indicates that for these four items male lecturers were more confident than female lecturers in their judgments about pre-service teachers' attitudes toward the use of ICT to enhance GNH principles and values.

6.4.3 Lecturer perceptions according to age

ANOVA was conducted to determine whether any statistically significant differences existed based upon lecturer age range for these 17 survey items. Full results are presented in Appendix Seven (Table A.7.2). No statistically significant differences (i.e., $p < 0.05$) were identified for these items indicating that the age of lecturers did not influence their perceptions about pre-service teachers' attitudes towards ICT enhancing GNH principles and values.

6.4.4 Lecturer perceptions according to teaching experience

ANOVA was conducted to determine whether any statistically significant differences existed based upon lecturer teaching experience for these 17 survey items. The results are presented in Appendix Seven (Table A.7.3). A statistically significant difference (i.e., $p < 0.05$) was identified for one item:

- *I am confident my students believe ICT is an effective tool to learn about media literacy* ($F(5,19)=2.81$, $p=0.046$).

Post Hoc Tests that could determine between which group(s) the significant results occurred were unable to be conducted due to at least one of the teaching experience groups having less than two cases. The teaching experience variable was re-coded into three groups: 10 years or less; 11 - 20 years; and 21 years and over. Repeating the Post Hoc Tests (Scheffe and Bonferonni) with the re-coded variable failed to identify any statistically significant difference between the teaching experience groups.

As a further precaution against a Type I error (i.e., a false positive) the Likert scale values for the item were re-coded from five levels (*strongly disagree, disagree, neither agree or disagree, agree, strongly agree*) to three levels (*disagree, neither agree or disagree, agree*) and the ANOVA repeated. Results of the ANOVA indicated there was no significant difference between the teaching experience groups for this item. Thus, to

avoid the possibility of a Type I error (i.e., a false positive) it was decided that there was no statistically significant difference between the groups for this item.

6.5 LECTURER TPACK

Lecturers were asked to assess their own TPACK using a five point Likert scale: 1. Strongly disagree (SD), 2. Disagree (D), 3. Neither agree nor disagree NAD), 4. Agree (A), 5. Strongly agree (SA). The full results are presented in Appendix 7 (Table A.7.5). For convenience and clarity, the responses to these survey items are presented in four sections corresponding to the TPACK dimensions surveyed: *Technological Knowledge* (TK); *Technological Content Knowledge* (TPK); *Technological Content Knowledge* (TCK); and *Technological; Pedagogical Content Knowledge* (TPACK).

6.5.1 Technological Knowledge (TK)

Six survey items assessed lecturer Technological Knowledge (TK). Frequencies of responses to these six items are presented in Table 6.7.

Table 6.7. Lecturer Technological Knowledge (TK)

Item	SD	D	NAD	A	SA	M	S.D.
I know how to solve my own technical problems	1 (3.8%)	11 (42.3%)	5 (19.2%)	9 (34.6%)	0 (0%)	2.9	0.97
I learn technology easily	0 (0%)	5 (19.2%)	6 (23.1%)	9 (34.6%)	0 (0%)	3.0	0.85
I keep up with new technologies	0 (0%)	5 (19.2%)	6 (23.1%)	15 (57.7%)	0 (0%)	3.4	0.80
I frequently play around with the technology	0 (0%)	4 (15.4%)	6 (23.1%)	13 (50%)	3 (11.5%)	3.6	0.90
I know a lot about different technologies	0 (0%)	13 (50%)	6 (23.1%)	2 (7.7%)	0 (0%)	2.6	0.64
I have the technical skills needed to use technology	0 (0%)	9 (34.6)	6 (23.1%)	10 (38.5%)	1 (3.8%)	3.1	0.95

Note: SD - Strongly disagree; D - Disagree; NAD - Neither agree or disagree; A - Agree; SA - Strongly agree

Lecturers gave a range of responses to questions associated with Technological Knowledge. Nearly half of lecturers (46%) either strongly disagreed or disagreed to the statement - *I know how to solve my own technical problems*. Only 35% of lecturers agreed with this statement. None of the lecturers, strongly agreed. In response to the statement *I learn technology easily,* 35% of lecturers disagreed, while 31% neither agreed or disagreed. Approximately one third of lecturers (34.5%) agreed with the statement. More than half of the lecturers (58%) agreed with the statement *I keep up with new*

technologies. The majority of lecturers (62%) either strongly agreed or agreed with the statement *I frequently play around with the technology*. However, half of the lecturers (50%) disagreed with the statement *I know a lot about different technologies*. Finally, 35% of lecturers disagreed with the statement, *I have the technical skills needed to use technology* with approximately 43% of lecturers either agreeing or strongly agreeing with this statement. Overall for Technological Knowledge, while the data suggests that many lecturers were willing to use and experiment with technology, many did not feel confident in their ability to solve technical problems or learn to use new technology. This is confirmed by the low means for the two items, *I know how to solve my own technical problems* (2.9) and *I know a lot about different technologies* (2.6).

6.5.2 Technological Pedagogical Knowledge (TPK)

Five survey items assessed lecturer Technological Pedagogical Knowledge (TPK). The frequencies of responses to these five items are presented in Table 6.8.

Table 6.8. Lecturer Technological Pedagogical Knowledge (TPK)

Item	SD	D	NAD	A	SA	M	S.D.
I know how to choose technologies that enhance student learning for a lesson	0 (0%)	3 (11.5%)	8 (30.8%)	15 (57.5%)	0 (0%)	3.5	0.71
I know how choose appropriate technologies to enhance teaching approaches for a lesson	0 (0%)	5 (19.2%)	5 (19.2%)	15 (57.1%)	1 (3.8%)	3.5	0.86
I think critically about how to use technology in the classroom	0 (0%)	1 (4%)	8 (32%)	16 (64%)	0 (0%)	3.6	0.58
I am confident to customise the technology that I own to different teaching activities	1 (4%)	4 (16%)	8 (32%)	12 (48%)	0 (0%)	3.2	0.88
I am able to select appropriate technologies to use in my classroom to enhance what I teach	0 (0%)	4 (15.4%)	5 (19.2%)	16 (61.5%)	1 (3.8%)	3.5	0.81

Note: SD - Strongly disagree; D - Disagree; NAD - Neither agree or disagree; A - Agree; SA - Strongly agree

There was a mix of responses for lecturer Technological Pedagogical Knowledge (TPK). While the majority (57.7%) of lecturers agreed with the statement – *I know how to choose technologies that enhances student learning for a lesson,* none of the lecturers strongly agreed. Close to one third of lecturers (30.8%) neither agreed or disagreed with this statement. This suggests some degree of uncertainty for lecturers knowing how to choose technologies to enhance student learning. For the statement – *I know how to choose appropriate technologies to enhance teaching approaches for lesson,* the majority of

the lecturers (60.9%) agreed or strongly agreed. On the other hand, 19.2% of the lecturers disagreed and 19.2% of lecturers neither agreed nor disagreed with this statement. The majority of the lecturers (64%) agreed with the statement - *I think critically about how to use technology in the classroom.* Only 4% of the lecturers disagreed while none strongly disagreed. However, close to one third (32%) of lecturers neither agreed nor disagreed with this statement. As previously, this suggests uncertainly on behalf of lecturers of their ability to think critically about how to use technology in their classrooms. Less than half of the lecturers (48%) agreed with the statement - *I am confident to customise the technology that I own to different teaching activities,* while none strongly agreed. There was a similar level of uncertainly expressed by lecturers for this item with 32% neither agreeing or disagreeing with this statement. Finally, the majority of lecturers (65.3%) agreed or strongly agreed with the statement - *I am able to select appropriate technologies to use in my classroom to enhance what I teach.* Only 15.4% of the lecturers disagreed and none strongly disagreed with this statement. However, 19.2% of the lecturers neither agreed nor disagree. Overall for Technological Pedagogical Knowledge, while the majority of the lecturers reported knowing how to use technology for pedagogical purposes, a relatively large proportion of lecturers expressed uncertainly about their ability to do so.

6.5.3 Technological Content Knowledge (TCK)

Three survey items assessed lecturer Technological Content Knowledge (TPK). The frequencies of responses to these three items are presented in Table 6.9.

Table 6.9. Lecturer Technological Content Knowledge (TCK)

Item	SD	D	NAD	A	SA	M	S.D.
I know how to choose appropriate technologies that enhance the development of GNH values in my lessons	0 (0%)	5 (20%)	4 (16%)	15 (60%)	1 (4%)	3.0	0.92
I know how to choose technologies that can enhance the content for a lesson	0 (0%)	4 (16%)	7 (28%)	14 (56%)	0 (0%)	3.5	0.87
I know how to select ICT that enhances what I teach	0 (0%)	4 (16%)	7 (28%)	14 (56%)	0 (0%)	3.4	0.76

Note: SD - Strongly disagree; D - Disagree; NAD - Neither agree or disagree; A - Agree; SA - Strongly agree

The TCK survey items produced a similar pattern of responses amongst lecturers. For the statement - *I know how to choose appropriate technologies that enhances the development of GNH values in my lessons,* 64% of lecturers either agreed or strongly agreed. One fifth

of lecturers (20%) disagreed and 16% neither agreed or disagreed with this statement. For the statement - *I know how to choose technologies that can enhance the content for a lesson,* 56% of lecturers agreed while none strongly agreed. Despite the majority of lecturers agreeing with this statement, 28% of lecturers neither agreed or disagreed while 16% disagreed. Finally, for the statement – *I know how to select ICT that enhances what I teach*, the majority of lecturers (56%) agreed, 28% neither agreed nor disagreed and 16% agreed. Overall, lecturers believed that they possess Technological Content Knowledge but as for Technological Pedagogical Knowledge, a relatively large proportion expressed uncertainly about their Technological Content Knowledge.

6.5.4 Technological Pedagogical Content Knowledge (TPACK)

Four survey items assessed lecturer Technological Pedagogical and Content Knowledge (TPACK). The frequencies of responses to these four items are presented in Table 6.10.

Table 6.10. Lecturer Technological Pedagogical Content Knowledge (TPACK)

Item	SD	D	NAD	A	SA	M	S.D.
I know how to use strategies that combine content, technologies and teaching approaches	1 (4.2%)	3 (12.5%)	7 (29.2)	12 (50%)	1 (4.2%)	3.4	0.92
I possess adequate skills to provide leadership in helping others to coordinate content, ICT and teaching approaches	1 (3.8%)	7 (28%)	9 (36%)	7 (28%)	1 (4%)	3.0	0.96
I am able to use strategies that combine content, ICT, and teaching approaches	1 (3.8%)	2 (7.7%)	9 (34.6%)	14 (53.8)	0 (0%)	3.4	0.80
I can appropriately combine, content, technologies and teaching approaches in a classroom lesson	0 (0%)	1 (3.8%)	O (0%)	10 (38.5%)	15 (57.7%)	4.5	0.71

Note: SD - Strongly disagree; D - Disagree; NAD - Neither agree or disagree; A - Agree; SA - Strongly agree

Lecturers gave a range of responses for the four TPACK items. The majority of the lecturers (54.2%) agreed or strongly agreed with the statement – *I know how to use strategies that combine content, technologies and teaching approaches*. There were 29.2% of the lecturers who neither agreed nor disagreed with the statement. The statement – *I possess adequate skills to provide leadership in helping others to coordinate the use of content, technologies and teaching,* was responded to with both a large degree of disagreement and uncertainty, with 31.8% of lecturers either disagreeing or strongly disagreeing

with this statement and 36% neither agreeing or disagreeing. For the statement – *I am able to use strategies that combine content, ICT, and teaching approaches,* the majority (53.8%) of lecturers agreed. However, over one third (34.6%) of lecturers neither agreed or disagreed. This suggests a level of uncertainty around the ability of lecturers to use strategies that combine content, ICT, and teaching approaches. Finally, despite some degree of uncertainly in the previous three TPACK survey items, the majority (96.2%) of lecturers either agreed or strongly agreed with the statement – *I can appropriately combine, content, technologies, and teaching approaches in a classroom lesson.* Overall, while the data suggests that lecturers did possess moderate knowledge about TPACK, the results suggest that lecturer ability to provide leadership in TPACK was poor.

6.5.5 Lecturer TPACK according to sex

Independent t-tests were conducted to determine whether any statistically significant differences existed between male and female lecturer for all TPACK items. Full results are presented in Appendix Seven (Table A.7.4). A breakdown of the results follows.

Technological Knowledge (TK)

No statistically significant differences (i.e., $p < 0.05$) were identified between male and female lecturer responses for these items indicating that male and female lecturers possessed similar Technological Knowledge.

Technological Pedagogical Knowledge (TPK)

A statistically significant difference (i.e., $p < 0.05$) was identified for one item:

- *I am confident to customise the technology that I own to different teaching activities* - Males ($M=3.47$, $SD=0.72$), Females ($M=2.75$, $SD=1.04$), $t(24)=2.03$, $p= 0.05$.

Male lecturers were significantly more confident than female lecturers in customizing technology to different teaching activities.

Technological Content Knowledge (TCK)

No statistically significant differences (i.e., $p < 0.05$) were identified between male and female lecturer responses for these items indicating that male and female lecturers possessed similar Technological Content Knowledge.

Technological Pedagogical Content Knowledge (TPACK)

No statistically significant differences (i.e., $p < 0.05$) were identified between male and female lecturer responses for these items indicating that male and female lecturers possessed similar Technological Pedagogical Content Knowledge.

6.5.6 Lecturer TPACK according to age

One-way ANOVA was conducted to determine whether any statistically significant differences existed for all TPACK items based upon age. The results are presented in Appendix Seven (Table A.7.5). A breakdown of the results follows.

Technological Knowledge (TK)

Statistically significant differences (i.e., $p < 0.05$) were identified for two items:

- *I frequently play around with the technology* ($F(4,21)=3.36$, $p=0.03$).
- *I have the technical skills needed to use technology* ($F(4,21)=3.78$, $p=0.02$).

Despite a significant ANOVA result, for the item, *I frequently play around with the technology* Post Hoc Tests (Scheffe and Bonferonni) failed to identify any statistically significant differences between the age groups. As previously, the Likert scale values for the item were re-coded from five levels (*strongly disagree, disagree, neither agree or disagree, agree, strongly agree*) to three levels (*disagree, neither agree or disagree, agree*) and the ANOVA repeated. Results of the ANOVA indicated there was no significant difference between the teaching experience groups for this item. Again, to avoid the possibility of a Type I error it was decided that there was no statistically significant difference between the groups for this item.

The Post Hoc Tests (Scheffe and Bonferonni), did however identify a significant difference for the item, *I have the technical skills needed to use technology* between the 26-30 and 36-40 age groups. The mean score of the 26-30 age group ($M=4.33$, $SD=0.58$) was significantly higher than the mean score of the 36-40 age group ($M=2.50$, $SD=0.85$). This indicated that lecturers in the 26-30 age group were more confident in their technical skills than lecturers in the 36-40 age group. There were no significant differences identified between lecturers in other age groups.

Technological Pedagogical Knowledge (TPK)

No statistically significant differences (i.e., $p < 0.05$) were identified indicating that lecturer age did not influence the Technological Pedagogical Knowledge.

Technological Content Knowledge (TCK)

No statistically significant differences (i.e., $p < 0.05$) were identified indicating that lecturer age did not influence the Technological Content Knowledge.

Technological Pedagogical Content Knowledge (TPACK)

No statistically significant differences (i.e., $p < 0.05$) were identified indicating that lecturer age did not influence the Technological Pedagogical Content Knowledge.

6.5.7 Lecturer TPACK according to teaching experience

ANOVA was conducted to determine if any statistically significant differences existed for all TPACK items based upon lecturer teaching experience. Full results are presented in Appendix Seven (Table A.7.6). A breakdown of the results follows.

Technological Knowledge (TCK)

No statistically significant differences (i.e., $p < 0.05$) were identified indicating that lecturer teaching experience did not influence Technological Knowledge.

Technological Pedagogical Knowledge (TPK)

No statistically significant differences (i.e., $p < 0.05$) were identified indicating that lecturer teaching experience did not influence Technological Pedagogical Knowledge.

Technological Content Knowledge (TCK)

No statistically significant differences (i.e., $p < 0.05$) were identified indicating that lecturer teaching experience did not influence Technological Content Knowledge.

Technological Pedagogical Content Knowledge (TPACK)

A statistically significant difference (i.e., $p < 0.05$) was identified for one item:

- *I am able to use strategies that combine content, ICT, and teaching approaches* ($F(5,20)=3.08$, $p=0.03$).

Post Hoc Tests were unable to be conducted due to at least one of the teaching experience groups having less than two cases. The teaching experience variable was then re-coded into three groups: 10 years or less; 11 - 20 years; and 21 years and over. Repeating the Post Hoc Tests (Scheffe and Bonferonni), identified a significant difference between the 10 years or less and 21 years and over groups. The mean score of lecturers in the 10 years or less group ($M=3.71$, $SD=0.49$) was significantly higher than the mean score of the 21 years and over group ($M=2.33$, $SD=1.53$). This indicates that lecturers with 10 years or less teaching experience were more confident in their ability to combine content, ICT, and teaching approaches than lecturers with 21 years or more teaching experience.

6.6 INTERNAL RELIABILITY

The values of Cronbach's Alpha for the relevant survey items are presented in Table 6.11.

Table 6.11. Cronbach's Alpha for survey scale items

Scale Items	**Cronbach's Alpha**
Attitudes towards GNH and GNH in education	0.72
Attitudes towards ICT in education	0.74
Attitudes towards ICT enhancing GNH principles and values	0.93
Technological Knowledge (TK)	0.86
Technological Content Knowledge (TPK)	0.87
Technological Content Knowledge (TCK)	0.79
Technological Pedagogical Content Knowledge (TPACK)	0.84

All scale items were within an acceptable range (0.6 to 0.8) of Cronbach's Alpha (Cooksey, 2014) suggesting an acceptable level of internal reliability for the survey items.

6.7 COMPARISON OF PRE-SERVICE TEACHER AND LECTURER WEB-BASED SURVEY RESULTS

This section provides the results of the comparison made between pre-service techer and lecturer responses to the respective web-based surveys.

6.7.1 Pre-service teacher attitudes and lecturer perceptions of pre-service teacher attitudes towards GNH and GNH in education

Independent t-tests were conducted to determine whether any statistically significant differences existed between pre-service teacher attitudes and lecturer perceptions of pre-service teacher attitudes towards GNH and GNH in education. Full results are presented in Appendix Seven (Table A.7.7). Statistically significant differences (i.e., $p < 0.05$) were identified between pre-service teacher and lecturer responses for all three items in this category:

- *I believe I possess adequate knowledge about GNH principles and values* - pre-service teachers (M=3.80, SD =0.67), lecturers (M=2.92, SD =1.06), t(25.8)=6.36, p= 0.00.
- *I believe GNH should be infused into my day-to-day teaching* - pre-service teachers (M=4.33, SD =0.66), lecturers (M=3.58, SD =0.90, S), t(26)=5.62, p= 0.00.
- *I believe it is necessary for pre-service teacher curriculum in Bhutan to reflect GNH* - pre-service teachers (M=4.30, SD =0.60), lecturers (M=3.65, SD =0.89), t(25.9)=5.21, p= 0.00.

For all three items in this category, pre-service teachers rated themselves higher than lecturers rated them. Thus, pre-service teacher attitudes towards GNH and GNH in education were more positive than what lecturers believed them to be.

6.7.2 Pre-service teacher attitudes and lecturer perceptions of pre-service teacher attitudes towards ICT in education

Independent t-tests were conducted to determine whether any statistically significant differences existed between pre-service teachers attitudes and lecturer perceptions of pre-service teacher attitudes towards ICT in education. Full results are presented in Appendix Seven (Table A.7.7). A statistically significant difference (i.e., $p < 0.05$) was identified between pre-service teacher and lecturer responses for one item in this category:

- *I believe ICT is an effective tool to create conducive learning environments for learners - pre-service teachers (M=4.16, SD =0.63), lecturers (M=3.77, SD =0.259), t(691)=3.12, p= 0.00.*

For this item, pre-service teachers rated themselves higher than lecturers rated them. For all other items in this category there were no significant differences between pre-service teachers and lecturers.

6.7.3 Pre-service teachers attitudes and lecturer perceptions of pre-service teacher attitudes towards ICT enhancing GNH principles and values

Independent t-tests were conducted to determine whether any statistically significant differences existed between pre-service teacher attitudes and lecturer perceptions of pre-service teacher attitudes towards ICT enhancing GNH principles and values. Full results are presented in Appendix Seven (Table A.7.7). Statistically significant differences (i.e., $p < 0.05$) were identified between pre-service teacher and lecturer responses for five items in this category:

- *I believe ICT tools have the potential to effectively internalize GNH values* - pre-service teachers (M=3.90, SD =0.66), lecturers (M=3.42, SD =0.81), t(687)=3.62, p= 0.00.
- *I believe ICT can be an effective tool to foster GNH to better become part of our* lives - pre-service teachers (M=3.95, SD =0.66), lecturers (M=3.48, SD =0.82), t(689)=3.50, p= 0.00.

- *I believe GNH values are enhanced more efficiently using ICT tools - pre-service teachers (M=3.78, SD =0.77), lecturers (M=3.46, SD =0.72), t(687)=2.03, p= 0.04.*
- *I believe ICT is an efficient tool to enhance GNH values such as integrity* - pre-service teachers (M=3.83, SD =0.63), lecturers (M=3.42, SD =0.70), t(687)=2.23, p= 0.00.
- *I believe ICT is a good tool to help me become more mindful about what I do* - pre-service teachers (M=3.85, SD =0.75), lecturers (M=3.44, SD =0.92), t(683)=2.69, p= 0.01.

For all five items in this category, pre-service teachers rated themselves higher than lecturers rated them.

6.7.4 Pre-service teacher and lecturer TPACK

Independent t-tests were conducted to determine whether any statistically significant differences existed between pre-service teacher and lecturer TPACK. The full results are presented in Appendix Seven (Table A.7.8). A breakdown of the results follows.

Technological Knowledge (TK)

A statistically significant difference (i.e., $p < 0.05$) was identified between pre-service teacher and lecturer Technological Knowledge (TK) for one item in this category:

- *I know a lot about different technologies* - pre-service teachers (M=3.02, SD =0.90), lecturers (M=2.58, SD =0.64), t(664)=2.36, p= 0.01.

Pre-service teachers rated themselves higher than lecturers rated themselves in knowing a lot about different technologies. For the other items in this category, there were no statistically significant differences between pre-service teachers and lecturers. This indicates that apart from this one item, pre-service teachers and lecturers had comparable Technological Knowledge.

Technological Pedagogical Knowledge (TPK)

No statistically significant differences (i.e., $p < 0.05$) were identified between pre-service teachers and lecturers for any of the items in this category. This indicates that pre-service teachers and lecturers had comparable Technological Pedagogical Knowledge.

Technological Content Knowledge (TCK)

No statistically significant differences (i.e., $p < 0.05$) were identified between pre-service teachers and lecturers for any of the items in this category. This indicates that pre-service teachers and lecturers had comparable Technological Content Knowledge.

Technological Pedagogical Content Knowledge (TPACK)

A statistically significant difference (i.e., $p < 0.05$) was identified between pre-service teacher and lecturer TPACK for one item in this category:

- *I possess adequate skills to provide leadership in helping others to coordinate the use of content, ICT and teaching approaches* - pre-service teachers ($M=3.34$, $SD=0.84$), lecturers ($M=3.00$, $SD=0.96$), $t(663)=-2.01$, $p=0.045$.

Pre-service teachers rated themselves higher than lecturers rated themselves in possessing adequate skills to provide leadership in helping others to coordinate the use of content, ICT and teaching approaches. For the other items in this category, there were no statistically significant differences between pre-service teachers and lecturers. This indicates that apart from this one item, pre-service teachers and lecturers had comparable Technological Pedagogical Content Knowledge.

6.8 CHAPTER CONCLUSION

This chapter presented the results of the lecturer web-based survey. In general, lecturers are positive about the pre-service teacher attitudes towards GNH and GNH in education and attitudes towards ICT in education. Despite these positive attitudes, lecturers perceived themselves as having only moderate TPACK and possessing limited skills to provide leadership in TPACK to others. Lecturers were less confident than pre-service teachers about the pre-service teacher attitudes towards ICT enhancing GNH principles and values. Although lecturers were positive about ICT enhancing GNH principles and values, they were not as confident in relation to their perceptions of ICT enhancing GNH principles and values. Overall, lecturers had lower perceptions of pre-service teacher capabilities and knowledges than pre-service teachers had of their own capabilities and knowledges.

The next two chapters (Chapter Seven and Chapter Eight) presents the results of the pre-service teacher focus group interviews and the lecturer semi-structured interviews.

CHAPTER SEVEN

PRE-SERVICE TEACHER INTERVIEW RESULTS

This chapter presents the results of the pre-service teacher focus group interviews, and comprises eights sections. The first section presents the demographic details of the pre-service teacher focus groups. The second section details the transciptions of the focus group interviews and presents a summary of the transcripts. The third section examines the in-depth coding of the focus group interview transcripts. The fourth section presents the two emergent themes that emerged from the analysis. The fifth and sixth sections examine the first emergent theme, *Affordances of ICT* and its associated sub themes: *Current ICT Usage* and *Future Transformative Actions*, respectively. The seventh section examines the second emergent theme, *Challenges of ICT*. The eight section provides a conclusion to the chapter.

7.1 PRE-SERVICE TEACHER FOCUS GROUPS - DEMOGRAPHICS

The qualitative data from the pre-service teachers was obtained through a series of 14 focus group interviews. Only 14 focus groups were organised and not 15 as was in the research plan because there were not enough participants to adequately fill 15 focus groups. Two focus groups also only had four participants and not six as originally planned. Table 7.1 presents the relevant demographic details of the focus groups.

Table 7.1. Demographics details of pre-service teacher focus groups

Focus Group	Year	Programme	Males (n)	Females (n)	Total (n)
PSTFG1	Fourth Year	BEd (Primary)	3	3	6
PSTFG2	Third Year	BEd (Secondary)	3	3	6
PSTFG3	Third Year	BEd (Primary)	3	3	6
PSTFG4	Third Year	BEd (Primary)	3	3	6
PSTFG5	Fourth Year	BEd (Secondary)	3	3	6
PSTFG6	Third Year	BEd (Primary)	3	3	6
PSTFG7	Second Year	BEd (Primary)	3	3	6
PSTFG8	Second Year	BEd (Primary)	3	3	6
PSTFG9	Fourth Year	BEd (Primary)	3	3	6
PSTFG10	First Year	BEd (Primary)	2	2	4
PSTFG11	Fourth Year	BEd (Dzongkha)	3	3	6
PSTFG12	Second Year	BEd (Dzongkha)	3	3	6
PSTFG13	Third Year	BEd (Dzongkha)	3	3	6
PSTFG14	First Year	BEd (Dzongkha)	2	2	4

7.2 TRANSCRIPTION AND SUMMARY OF FOCUS GROUP INTERVIEWS

In this section the procedure for transcription of the focus group interview data and the preliminary analysis of the interviews are presented.

7.2.1 Interview Protocol

To review, focus group interviews were conducted in accordance with the protocol described in Chapter Four to facilitate a responsive and successful interviewing process. The interview questions comprised eight broad seed questions (see, Figure 4.1) with linked strategies to probe for deeper responses.

7.2.2 Transcription

The 14 focus group interviews were transcribed and summarised employing a basic content analysis procedure linked to the interview questions. The purpose of these summaries was to allow the researcher to familiarise himself with the data. An overall summary of the ideas in the data is presented next to provide an overview of the interview proceedings.

7.2.3 Overall summary of transcripts

The summaries were condensed and the content was classified utilising the following seven ideas based on the seed interview questions: *Common ICT tools used by pre-service teachers, Pre-service teacher current practice of using ICT*, *Pre-service teacher perceptions of ICT*, *Support in using ICT*, *Impacts of ICT on GNH values*, *Impediments to using ICT,* and *Conditions necessary for using ICT.*

Common ICT tools used by pre-service teachers

Pre-service teachers reported using different types of ICT that fell under four categories: hardware, software, Internet, and Apps. The hardware included: computers, laptops, and mobile/smart phones. The main software used were word processors, spreadsheet, and PowerPoint presentation tools. Internet/web tools such as blogs, Google Docs, and social networking tools (Facebook) were other forms of ICT utilised by the pre-service teachers. The college LMS (Moodle) was extensively used primarily for academic purposes. Pre-service teachers also reported using different Apps that come with mobile/smart phones, such as Viber, WeChat, WhatsApp, and Skype, mainly for communication purposes.

Pre-service teacher current practice of using ICT

The pre-service teachers reported using different ICT for both formal and informal purposes. However, the pre-service teachers mainly utilised the free Apps for informal communications. Pre-service teachers considered the Internet as their primary learning resource and reported using the Internet and web tools such Google extensively for exploring web-based learning materials. The most commonly used ICT for learning at the college was the college Moodle LMS. The college mandated that all lecturers and pre-service teachers used Moodle specifically for academic purposes. Pre-service teachers also thought the use of ICT was beneficial as interactive presentations using PowerPoint presentations were better and more stimulating compared to the traditional methods of delivery where a chalkboard was used to present the lesson. Social networking tools, such as Facebook, were popular among pre-service teachers and were utilised for both educational and personal purposes. Apps such as WeChat, Viber, and WhatsApp on mobile/smart phones were common and useful communication tools that enabled pre-service teachers to communicate with lecturers, peers, and family members.

Pre-service teacher perceptions of ICT

Pre-service teachers perceived ICT as an almost indispensible tool because ICT not only assisted in learning but also was useful for their personal lives. Pre-service teachers perceived ICT as beneficial to them in four main ways. First, ICT such as the Internet provides an excellent reservoir of learning resources where pre-service teachers are able to access up-to-date learning materials. Second, pre-service teachers thought using ICT resources was more sustainable as materials can be used and re-used, unlike in the past when materials had to be printed to be shared. Third, pre-service teachers perceived ICT as a tool that creates an environment in which they can enhance their analytical thinking and creativity; important characteristics of GNH principles and values. Fourth, pre-service teachers perceived ICT as an efficient learning tool because these tools are collaborative, interactive, flexible, engaging, and constructive in nature. Using these ICT tools pre-service teachers thought helps remove a lot of inhibitions particularly for shy pre-service teachers who are not comfortable in participating in face-to-face discussions.

Support in using ICT

The pre-service teachers reported that in order to assist them in using ICT to enhance their learning, the college has provided them with three kinds of support. First, the

college has set up five computer laboratories with Internet connections for them to use. Second, they reported having access to Wi-Fi infrastructure in and around the college campus including the pre-service teacher hostel areas. Third, pre-service teachers reported that the college has provided them with the VLE, Moodle, so that they are able to use ICT to enhance their learning.

Impact of ICT on GNH values

Pre-service teachers across the focus group interviews reported that ICT is a useful tool to enhance GNH values. For example, they mentioned that many GNH values such as sustainability, time use, creativity, problem solving, critical/analytical thinking, respect, and sharing that can be enhanced using ICT.

Impediments to using ICT

The pre-service teachers reported seven types of impediments to using ICT at the college. First, access to computers was limited. They mentioned that since the number of computers in the laboratories is much less than the number of users, they often find it difficult to avail themselves of the computer facilities. Pre-service teachers depended heavily on Internet resources for their learning and the problems related to inadequate numbers of computers in labs was seen as an impediment to using ICT. The amount of broken computers that were not maintained aggravated the problem of inadequate number of computers in the labs. Second, the Internet was slow due to low bandwidth. Since the Internet is the primary learning resource for pre-service teachers, slow Internet significantly impacted on their learning. Third, limited availability of Wi-Fi facilities across the college. Pre-service teachers reported that Wi-Fi facilities are not available throughout the campus and even though installed in most classrooms a Wi-Fi signal is often not available. In the pre-service teacher hostel areas a Wi-Fi connection was available but was blocked during the day plus the signal in the evening was often weak. Fourth, although pre-service teachers used different ICT devices such as smart phones, these were not allowed to be used in class. These devices come with many different Apps and are seen as useful tools for learning. This rule was seen as an impediment to pre-service teacher use as these devices were important for their learning particularly outside of the classroom. Fifth, lack of adequate ICT skill was often a hindrance to pre-service teachers to effectively use ICT at the college. Sixth, the administrators blocked access to social media. Pre-service teachers reported using social networks extensively, of which Facebook was the most common, for learning as

well as for personal communication. Finally, pre-service teachers reported that support from the technical staff was not effective or adequate.

Conditions necessary for using ICT

Pre-service teachers believed in order to be able to reap the full potential afforded by ICT, three important measures had to be undertaken. First, the number of computers available in the laboratories needed to be increased and all computers should be functional. Second, there should be an adequate amount of technical support from the technical staff making sure timely maintenance was carried out including updating the antivirus program as viruses were seen as a common cause of computers not functioning adequately. Third, as the Internet was considered a crucially important learning resource, bandwidth had to be improved.

7.3 IN-DEPTH CODING OF FOCUS GROUP TRANSCRIPTS

Following the Braun and Clarke (2006) thematic analysis procedure, in-depth coding of the transcripts was carried out. Prior to the actual coding, all the focus group interview transcripts were read and summarised (presented in previous section) in order to become familiar with the data.

7.3.1 Coding Process

The 14 pre-service teacher interview audio recordings gathered through focus group interviews were analysed using the six phases of thematic analysis proposed by Braun and Clarke (2006): *Familarisation with data; Coding; Searching for themes; Reviewing themes; Defining and naming themes; and Writing up*, as described in Chapter 3. In this study the text of the transcripts was arranged in a table with four columns: *category*, *transcript, theme and reflection*. Part of the coding table is shown in Figure 7.1. The handwritten annotations represent the steps taken to initially identify codes. Relevant information from the later phases, to decide on categories and themes, were added in the relevant columns during the process.

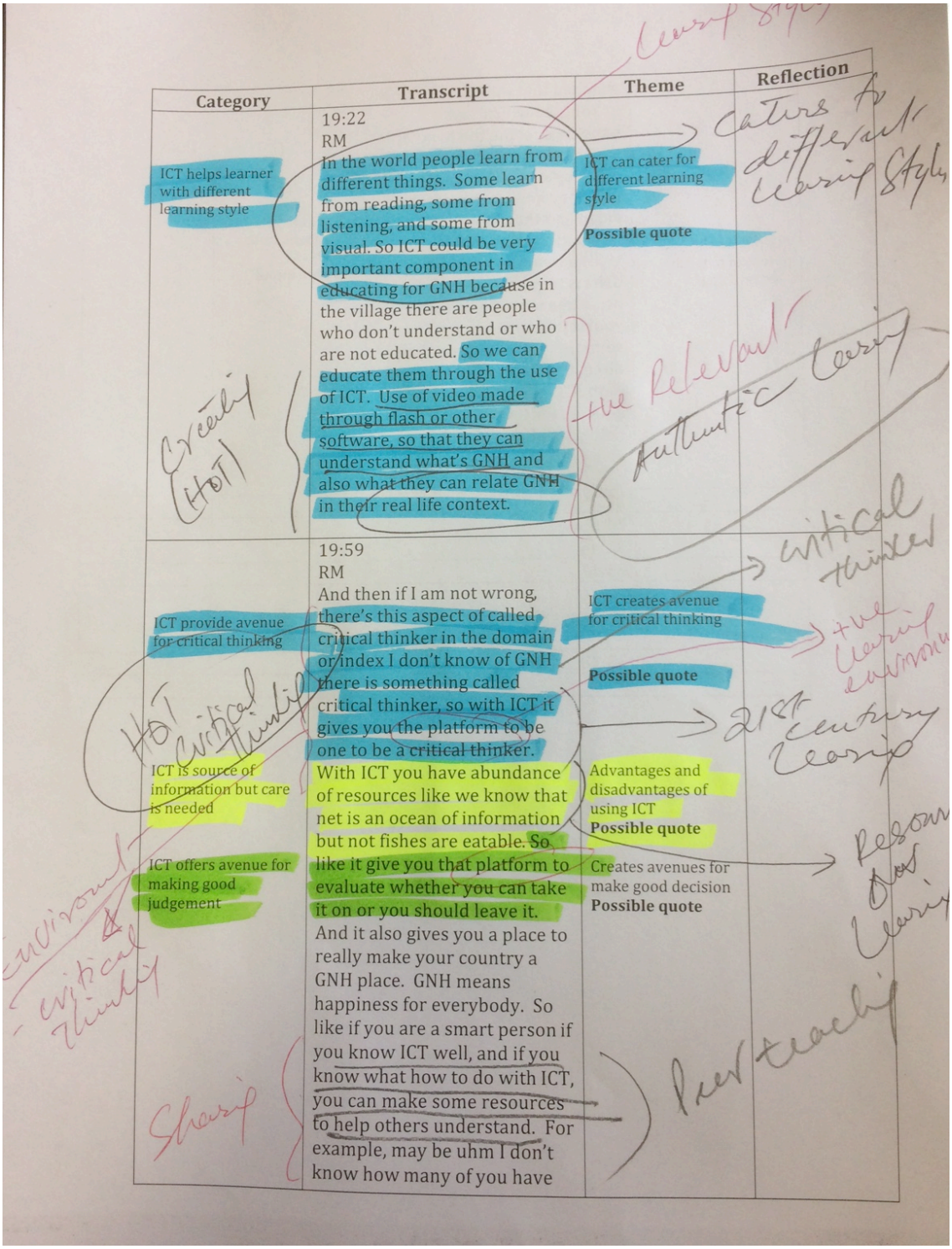


Figure 7.1. Part of coding table used for the coding process

For the first phase, *Familarisation with data*, all transcripts were read whilst listening to the audio recording to become familiar with the data and capture nuances lost in the transcription process. Reading transcripts and listening to the audio recordings at the same time enabled the researcher to immerse himself in the data and begin to explore relationships before coding commenced. For the second phase, *Coding*, the transcripts

were read and re-read to generate codes, which were assigned, using words, phrases, and/or short sentences. These codes were identified and recorded on the coding table. Possible representative quotes were identified and recorded by highlighting relevant words. This coding of the pre-service teacher focus group interview data was undertaken in parallel with the coding of the lecturer semi-structured interview data whose analysis is reported in Chapter 8. This was done because initial reading of the transcripts indicated sufficient similarity to justify analysis in parallel.

At this juncture, to assist in generating qualitative research that is "plausible, credible, trustworthy and therefore defensible" (Johnson, 1997, p. 282), two of the researcher's thesis supervisors each coded the data separately and the resulting coding was compared with the coding produced by the researcher. The aim was to develop a set of agreed code descriptions. Next, all parties individually re-coded the data using this set of agreed code descriptions and through an iterative process of consensus, the final codings were developed. The identification and description of the emergent themes employed this same iterative process of consensus. This use of 'analyst triangulation' (see, Table 3.4) was done to maximise the validity of the research. In all, 30 different codes were identified and these are named below in the description of the themes.

7.3.2 Categories

Upon completion of the iterative re-coding process, the codes were analysed and grouped to generate categories to capture the inherent meanings in each transcript. An iterative process of reading transcripts, suggesting categories, re-reading transcripts and reviewing categories was performed to generate a suite of agreed categories and description for each category. The basis for generating such categories is integral to thematic analysis because these categories provide new understanding of the data and form the foundation for identifying themes. The seven categories identified were: *Access, Affective state, College policy, Communication, Environment, Skills,* and *User characteristics*. Description of the themes developed from these seven categories follows. As with the derivation of codes, the derivation of categories and the revelation of emergent themes were undertaken with the pre-service teacher focus group interview data in parallel with the analysis of the lecturer semi-structured interview data.

7.4 PROCESS TO REVEAL EMERGENT THEMES

For the third phase, *Searching for themes*, the seven categories were analysed in order to identify storylines and themes present across the 14 transcripts. The first step in the analysis to assist in the identification of themes involved the process of grouping categories, and their linked codes, that shared similar features. Then the researcher, in conjunction with the supervisory team, proposed, examined and debated emergent themes. The process resulted in the identification of two robust themes: *Affordances of ICT* and *Challenges of ICT*. These two themes are described below.

7.4.1 Affordances of ICT

The first theme, *Affordances of ICT*, has five categories and 21 associated codes (Table 7.1). This theme is made up of two sub-themes - *Current ICT Usage* and *Future Transformative Actions*, which represent two dimensions, current practice and future practice. The theme *Affordances of ICT* was divided into two sub-themes because analysis of the data indicates that some points that the pre-service teachers made related to the actual benefits that they are reaping from the affordances of ICT while other points made related to what they thought were possible benefits to their learning.

The sub-theme *Current ICT Usage* represents current practice and mainly includes the beneficial aspects of pre-service teachers use of ICT in day-to-day learning. The sub-theme *Transformative Actions* represents future practice as the potential to change teaching and learning when using ICT tools, such as computers, laptops, iPads, mobile/smart phones, Apps, and web tools. For each category within a particular sub-theme, the coding of the transcript quotes did not necessarily result in the use of every code listed in Table 7.2 for that category.

Table 7.2. Affordance of ICT - associated categories and codes

Category	**Code**
Access	Availability Equity Restrictions
Affective states	Engaging Enjoyable Motivating Overcoming anxiety
Communication	Collaboration Connectedness Interaction Sharing

Category	Code
Environment	Authentic Convenient Customisation (creativity) Efficient Empowering Innovative Relevant Transformative
User characteristics	Learning styles Self-directed

7.4.2 Challenges of ICT

The second theme, *Challenges of ICT*, is defined as those elements that act as barriers to the pre-service teachers being able to make use of ICT. This theme comprises three categories and six codes (Table 7.3).

Table 7.3. Theme: Challenges of ICT - associated categories and codes

Category	Code
Skills	ICT
Access	Internet bandwidth Computers Wi-Fi facilities
College policy	Restrictions to hardware usage Restrictions to Internet usage

Detailed descriptions of each category, including quotes from the pre-service teacher focus group interviews, follows, first for each of the two subthemes of the theme *Affordances of ICT*, then for the theme *Challenges of ICT*.

The direct quotes from pre-service teachers, presented in this chapter, may not be grammatically correct as the text has come in the form of conversation as typically expressed by Bhutanese people. The direct quotes from the pre-service teacher focus group interviews are labelled with the focus group number, e.g., PST FG4 means pre-service teacher focus group number 4.

7.5 THEME: AFFORDANCES OF ICT; SUB-THEME: CURRENT ICT USAGE

The Current ICT Usage affordances of ICT are reported under the five categories: *Access, Affective states, Communication, Environment,* and *User characteristics*, as presented in Table 7.2.

7.5.1 Category: Access

Access is defined as those factors that determine the pre-service teachers' ability to utilise ICT for different purposes. Within this category there were two codes: *availability*, and *equity.*

The access to different ICT plays an important role in the life of pre-service teachers at the college in their ability to reap the full potential of ICT. The maximum benefits from ICT are largely dependent on how much access pre-service teachers have to hardware, software, web tools, and applications. If pre-service teachers have access to different ICT tools they are likely to use them for intellectual purposes as depicted in one of the group responses:

> So while teaching and learning, in teaching and learning we use ICT as tool like communicative tool, constructive and co-constructive tool and many other tools. So while for example in communicating tools we through ICT we use social networking like blogs, VLE … (PST FG2).

Those pre-service teachers who do not own their own ICT are likely to be disadvantaged because they do not have any ICT to use when the computers in the labs are not available. "I think those who don't have mobile phones and iPads, so for them it would be very difficult for them to fulfil GNH through ICT" (PST FG7). It is an indication of equity issues where those who own personal ICT are at a advantage compared to others.

7.5.2 Category: Affective states

Affective states includes those elements that contribute to fulfilling emotional and psychological desires and experiences of the pre-service teachers. Within this category there were four codes: *engaging*, *enjoyable, motivating*, and *overcoming anxiety*.

Pre-service teachers perceived ICT as a meaningful and engaging tool which makes learning enjoyable, for example, "It is the competency to initiate like framing activities so that it can provoke student's curiosity, curiosity to explore new things, come up with initiatives, being independent learners and many more like at times they can be creative with the use of ICT" (PST FG4). These types of affordances of ICT are also seen as motivating for pre-service teachers as they are able to engage in such meaningful learning activities with ICT. The motivating role played by ICT is typified in what one

group said: "using ICT motivates students and using chalkboard is no more fun" (PST FG12).

Another group mentioned that when students are motivated the retention rate is higher: "Using ICT in teaching motivates learners and because learners are motivated the retention of what is learnt is also good and learners are able to remember more" (PST FG13).

Another affordance of ICT is that using ICT enables pre-service teachers to participate actively both in face-to-face classroom as well as outside the physical classrooms. Pre-service teachers think that such affordances of ICT help in removing inhibitions and overcoming anxiety related to cultural beliefs. This type of affordance is featured in one of the groups: "… because we Bhutanese have a belief that when we are in front of the teachers we feel very awkward. So when we use ICT especially when the group is created then it is very convenient for us" (PST FG1).

Another group corroborated by expressing: "Like we learn from everyone, we learn from everyone who's on site… because may be its social network it's not formal class students are not reluctant, students are not scared of what teacher would say" (PST FG5).

7.5.3 Category: Communication

This category is defined as the mode of interaction among pre-service teachers, lecturers, and parents that can be either formal or informal. Communication enables asking of questions, sharing of thoughts and ideas; and finding solutions to problems through collaboration. ICT tools facilitate communication of different types and the communication enhances pre-service teachers learning as well as helping to enhance their relationship with teachers, peers, and family members. Within this category there were four codes: *collaboration, connectedness, interaction,* and *sharing*.

Communication afforded by ICT enables active, interactive, or learning-by-doing. Pre-service teachers reported enjoying active learning-by-doing using ICT tools and one such example is the collaborative learning, illustrated in: "We tend to have some tend to develop some collaborative environment in which if one is facing problem the other is always there to help us and in this case I think GNH value some GNH value is taught" (PST FG2).

Another group shared the same idea:

> But with the help of ICT now we have many many group blogs and Facebook whereby we invite many friends and through that in the middle of the night even if you have a problem we can contact teachers, we can contact friends, we can put up questions, we can get many answers (PST FG10).

The power of communication through ICT is its ability to create an environment for interaction. The interaction enabled by ICT not only promotes sharing but also helps pre-services teacher maintain relationships with lecturers, peers, and family, as typified by: "Through Internet we are able to share our thoughts and emotions. All the and sometimes we are able to solve our problems through communications, through video chats and all sir" (PST FG10). One of the most extensively used ICT tools for communication is Facebook, which is evident in: "Facebook is the only means we can connect with our friends though they are miles apart from us" (PST FG8).

7.5.4 Category: Environment

This category is defined as the conditions and context that transforms pre-service teachers' learning. Within this category there were eight codes: *authentic, convenient, customisation, efficient, empowering, innovative, relevant,* and *transformative.*

The kind of environment that ICT affords encourages pre-service teachers to repurpose and innovate using ICT tools and transforming learning. One such example was: "So using ICT we can create more ideas, we can just pass the ideas. We can teach ideas to students usually using ICT. So using ICT is more resourceful than using the prescribed text" (PST FG1). Pre-service teachers from another group pointed out that ICT creates environments that allow critical thinking: "So with ICT it gives you the platform to be one to be a critical thinker" (PST FG5) and the same group continued: "… so that it can provoke students' curiosity, curiosity to explore new things, come up with initiatives, being independent learners and many more like at times they can be creative with use of ICT" (PST FG5).

An ICT-enabled learning environment creates opportunities for authentic and innovative learning that empowers and allows creativity. One such example is: "We can also use like JavaScript and Flash so that you can make the things according to your topic and you can project it to the students so that it becomes interactive as well as it creates liveliness in the learning process" (PST FG5).

Learning in an ICT-enabled environment makes it possible for pre-service teachers to contextualise their learning which is depicted in: "He sang a rhyme and along with that he put some pictures he browsed in the net and he put some pictures and he made Dzongkha nursery rhyme that created related to health" (PST FG3).

7.5.5 Category: User characteristics

This category is defined as the type and level of use the pre-service teachers make of ICT as part of their learning. Within this category there were two codes: *learning styles,* and *self-directed learning*.

Availability of different types of ICT tools influences the type of use pre-service teachers make of the ICT, as shared in: "But if you change our style and if we project visual if we make them to see the real picture of solar system you know the students get engaged, they learn, they want to explore more beyond the text" (PST FG3). This is an example of why different learning styles are encouraged.

Another group corroborated the claim by sharing their experiences and observations of how their friends learn better because ICT addresses different learning styles:

> ..what I have noticed is they learn through seeing Sir. Like we also we also know that like when our lecturer teaches us verbally we don't understand much. But if the ICT was like put up and we could atleast we our attention gets to that and like we learn more (PST FG4).

Availability of different types of ICT tools influences the type of use pre-service teachers make of the ICT and helps to extend their learning beyond the bounds of their conventional classrooms. This assists in developing ownership of learning as well as managing their own learning. These self-directed learning affordances of ICT are evident in:

> Wherever we are if we have access to net, we can click and even the teachers who are doing DE [distance education] in the school they do not have to come here to the college. They get their access if they have access to the Internet its like they are in the college. (PST FG6)

7.6 THEME: AFFORDANCES OF ICT; SUB-THEME: FUTURE TRANSFORMATIVE ACTIONS

The Future Transformative Actions affordances of ICT are reported under the five categories: *Access, Affective states, Communication, Environment, and User characteristics*, as presented in Table 7.2.

7.6.1 Category: Access

This category is defined as the different types of ICT infrastructure that pre-service teachers have the potential to utilise in the future. Within this category there were two codes: *availability, and restrictions.*

Better access to different ICT, pre-service teachers thought, could bring about transformational changes to the ways they learn because ICT is likely to support them to learn at anytime. For example: "for me I use mobile in two way, two way. One in order to learn and one to update my information. First when it comes to learning I use mobile whenever there is net facilities in the college" (PST FG1). Pre-service teachers thought using ICT could change the nature of their learning from lecturer-driven to more pre-service teacher driven as reported in: "We say that we should learn by doing, we say that our teaching and learning should be student-centred. So I think ICT really helps in that"(PST FG5).

And even more pertinent view came from group who thought that ICT could transform their way of learning making it easier and more efficient:

> At one touch you have the whole world in your hand. So your day-to-day learning is again expanded here as well as for the module, get the notes, capture the notes, you don't have the notes your friends have it picture it,. Why do you have to copy it down in your notebook? (PST FG5).

However, the transformative power of ICT can be hindered if there are restrictions to using ICT. Pre-service teachers mentioned that blocking social networking tools, such as Facebook, hinders their ability to transform the way they learn. Limiting pre-service teacher use of social networking tools is a stumbling block as they are not able to reap the full potential of ICT, "There is a Facebook, Facebook service on the Internet and that ahm ... if used correctly, its very you know innovative way to learn, to, share our information online" (PST FG5).

Lack of access to social media tools is also perceived to be preventing pre-service teachers from experiencing flexible and personalised learning opportunities afforded by such tools: "Like we learn from everyone, we learn from everyone who's on site … Because may be its social network it's not formal class students are not reluctant, students are not scared of what teacher would say" (PST FG5).

7.6.2 Category: Affective states

This category pertains to creating emotional and psychological ambience to pre-service teacher learning using ICT tools that has potential to transform learning. Within this category there were four codes: *engaging, enjoyable, motivating,* and *overcoming anxiety.*

ICT has the potential to impact the way pre-service teachers learn by making their learning engaging and enjoyable:

> And sometimes we also use the video clips and which makes the students happy and feel free to learn and so it involves more of student rather than teacher-centeredness and so they feel free to discuss with their teachers and also with their friends" (PST FG7).

Using ICT also motivates pre-service teachers to learn which helps them to retain what is learnt, as typified in: "Using ICT in teaching motivates learners and because learners are motivated the retention of what is learnt is also good and learners are able to remember more" (PST FG13).

Engaging and motivating learning opportunities supported by ICT can significantly impact pre-service teachers emotionally and psychologically. Pre-service teachers reported that ICT, particularly communication facilitated by different ICT tools, can not only have a motivational impact but also has the potential to help them to overcome their inhibitions or anxiety, as depicted in:

> I like we learn from everyone, we learn from everyone who is on the site sometime we learn but its upto us to evaluate like whether it's the correct one or not and to back what [focus group member] already said I think because may be its social network its not formal class students are not reluctant, students are not scared of what the teacher say (PST FG5).

7.6.3 Category: Communication

This category is defined as the medium through which collaboration, cooperation, and interactions can take place. Within this category there were three codes: *collaboration, connectedness,* and *sharing.*

One of the potential affordances of communication tools is that they allow collaborative learning where talents and expertise from different members work together for a common goal. Pre-service teachers reported that using communication tools has the potential to enable them to learn differently rather than listening to lecturers' traditional mode lesson delivery using the projectors as well as opportunities to learn from experts from other countries. A beneficial aspect of using communicative tools for collaboration is illustrated in:

> So whatever he said like video conference and all, it should be there so that we can also learn from that people like foreigner people. We can have conference and we can learn new technologies, we can learn new ideas about teaching and all rather just coming with projectors, tutors teaching us, it will be better if we do conferences with foreigner people… (PST FG6).

Another aspect of communication facilitated by ICT tools is that they enable pre-service teachers to keep in constant contact with lecturers, peers, and family without additional cost. The communication afforded by ICT also allows interaction and sharing of thoughts and ideas: "Through Internet we are able to share our thoughts and emotions. All the and sometimes we are able to solve our problems through communications, through video chats and all sir" (PST FG10).

7.6.4 Category: Environment

This category is a setting created by the utilisation of ICT tools that has the potential to change the nature and the approaches to teaching. Within this category there were seven codes: *authentic, convenient, customisation (creativity), empowering, innovative, relevant, and transformative.*

The ICT-enabled environment can create student-centred learning and learning can resemble the real-world situation and can be more realistic to pre-service teachers. This is evident in: "Teaching using ICT is more realistic because when lessons are presented using ICT it looks almost real and children are able to remember better about what they have learnt" (PST FG13). Another group made similar comments which

corroborates this: "Creating using mobile makes their learning authentic because it sounds so real to them" (PST FG12).

In an ICT-enabled environment learning can be innovative, effective and exciting: "Using JavaScript also we can do like that and then Flash and all. It will make our teaching and learning more effective and more interesting" (PST FG5).

And ICT enabled environment can also help transform learning where pre-service teachers can be empowered, take initiatives and take control of their learning.

> It is the competency to initiate like framing activities so that it can provoke students' curiosity to explore new things, come up with initiatives, being independent learners and many more like at times they can be creative with the use of ICT (PST FG5).

A learning environment enabled by ICT provides opportunities where pre-service teachers learn in certain contextual settings. Use of some web applications make it possible for such contextual learning typified in how Google Maps could prove useful: "We could mark all the places on the Google map and make it a map so that students could learn. We could even do it with the lineage of Zhabdrung Ngawang Namgyel, the places he visited, the places he built Dzongs, something like that" (PST FG5).

7.6.5 Category: User characteristics

This category is defined as a specific kind and level of pre-service teacher ICT users for both formal and informal purposes. Within this category there were two codes: *learning styles*, and *self-directed learning*.

The pre-service teachers believed that using ICT can meet the needs of varying learning styles and allow for self-directed learning opportunities with flexibilities to engage in more exploratory learning using different ICT tools, as evident in:

> But if you change our style and if we project visual if we make them to see the real picture of solar system, you know the students get engaged, they learn, they want to explore more beyond the text. So I think this ICT motivates the feelings of students (PST FG3).

The ICT-enabled environment allows pre-service teachers the opportunity to create new artefacts by the mash-up of different multimedia files or objects: "We merged all the videos then like we did one H … aerobic dance and like we merged the songs with our steps then we did with it and it was more fun sir" (PST FG4).

Pre-service teachers reported about how ICT can help them to learn independently at their own pace where they take the initiative for collaborative and reflexive conversations, such self-directed learning as depicted in:

> And top of that its not always that we need lecturer or teacher guiding us all the time. In previous years or olden days it used to happen that teacher instruct every time students, but now we have facilities like tutorials and Internet services which we can learn through tutorials and which it can enhance our knowledge (PST FG2).

A similar view was shared by a group, where the pre-service teachers thought that they should take full control of their learning: "So I think self-exploration is very important for students to learn and explore the information and ICT is good information provider "(PST FG5).

7.7 THEME: CHALLENGES OF ICT

The Challenges of ICT are reported under the three categories: *Skills*, *Access,* and *College policy,* as presented in Table 7.2.

7.7.1 Category: Skills

This category is about pre-service teachers ability to use certain ICT tools. Within this category there was one code: ICT.

Analysis showed that ICT usage by pre-service teachers is constrained by inadequate ICT skills. They argued that the college needs to support them with additional ICT skills which is evident in:

"So I think it will be better if we held workshop or something to help students how to make better use of laptops and desktops Sir" (PST FG7). Another group shared similar observations on the lack of ICT skills:

> I think the college must provide some basic fundamentals about ICT tools, ICT knowledge to students because in my experiences I found out that some of my colleague friends they don't know how to use ICT tools and they were discouraged to do presentations and don't feel like going into ICT lab and they were feeling like low (PST FG10).

This issue was corroborated by:

> "In this college to be frank we are not really given what we call good knowledge on ICT. So only in first year we are given the chance to make result sheet through ICT" (PST FG3).

7.7.2 Category: Access

This category includes those conditions that are available to pre-service teachers such as access to a good Internet connection, and access to hardware such as the computers and Wi-Fi connections. Within this category there were three codes: *Internet bandwidth, computers,* and *Wi-Fi facilities.*

Pre-service teachers utilised Internet for most of their academic related activities. The overwhelming problem pre-service teachers saw with regard to the Internet is its slow speed at the college, which is impacting effective use of Internet resources on which they depend. This frustration is shared in: "And even with the Internet its very slow sometimes. Then like to get loaded that page we have to wait thirty minutes" (PST FG4). Another group expressed a similar grievance:

> "That it is ok in the labs and lecture theatre building, but in classrooms when we need the internet most, there we find inaccessible when we are in dire in need of Internet that's what I found not effective" (PST FG9).

With yet another group pointing out:

> "And secondly, most of the time most of the time our friends they depend on the net to share something and so if there is no if the speed is low to the server, I think it will be and this the one which is stopping us" (PST FG6).

Another area of concern related to access is the difficulty accessing the hardware infrastructure, particularly in the laboratories. This access is constrained by two things: the inadequate number of computers in the laboratories compared to the number of pre-service teacher users and the number of non-functioning computers. The problems related to inadequate number of computers posing a challenge to pre-service teachers is depicted in:

> Sometime when all the classes are free together then we have to rush and it is first come first basis and by the time they go out free time is over we don't get to use that the facilities there. Not enough computers (PST FG4).

If pre-service teachers are to leverage the potential of ICT then there should be an adequate number of computers in the laboratory: "More number of desktops and at the same time uhm … we would like to have IT people more active" (PST FG8).

Pre-service teachers reported that the many computers that are broken due to a variety of different reasons hinder access resulting in a poor user-computer ratio. In particular, pre-service teachers pointed out that computers are made functionless due to virus infection, as typified in:

> Our lab computers are they have provided enough computers but some are not working well and some one which are working are also full of viruses which spoils our thumb drives and sometimes it makes us very difficult to submit our assignment when time come (PST FG8).

Many pre-service teachers possess personal ICT devices and use them extensively for different purposes. This usage is often hampered by erratic, sometimes non-available, Wi-Fi facilities at different locations across the campus. Pre-service teachers also mentioned that using mobile devices eases the problem of the inadequate number of computers in the laboratory. The need to improve the Wi-Fi facilities is evident in:

> I think college need to increase the speed of the server and Wi-Fi connectivity has to be at least in college campus or here in the Rinpung campus should be getting connected to WI-FI everywhere in the college campus that we don't have right now (PST FG6).

7.7.3 Category: College policy

This category comprises the rules and regulations that the college has in regards to using ICT at the college. The college has certain rules that prohibit pre-service teachers from using ICT infrastructure, such as restrictions on using social media. These rules hinder the pre-service teachers' ability to leverage the full potential of ICT. The college rules have a direct bearing on pre-service teacher learning, as they cannot utilise ICT at certain times of the day and at certain places on the campus. Within this category there were two codes: *restrictions on hardware usage,* and *restrictions on Internet usage.*

The policy of the college is that access to Wi-Fi in some locations during the class hours is restricted for pre-service teachers. For instance, Wi-Fi connection to the pre-service teachers' hostel is blocked between 9.00 am to 4.30 pm. Pre-service teachers think that when they are free they should be allowed to use the Internet from anywhere within the college: "We are not packed in a day and we get some free times and if could the

lab is already packed and we could not do the work. If the Wi-Fi net is connected we can do the things" (PST FG3).

The other challenge pre-service teachers reported are restrictions posed on accessing certain web facilities, which they think, are important to their learning. Some of the web facilities such as Facebook and YouTube are blocked by the network administrator during class hours: "During the college hours the ICT persons are blocking that website that Facebook website and they were letting us to browse that website after college hours" (PST FG3). Another group shared this displeasure in: "But some are important they are not allowing us to access to this which is totally banned by the administrator like YouTube" (PST FG6).

7.8 CHAPTER CONCLUSION

This chapter presented the results of the pre-service teacher focus group interviews. From thematic analysis two major themes emerged: *Affordances of ICT* and *Challenges of ICT*. The theme *Affordances of ICT* is made up of two sub-themes, *Current ICT Usage* and *Future Transformative Actions*. The codes resulting from the analysis sometimes varied for any particular category, across the themes and sub-themes. These themes and sub themes are carried over and discussed more fully in Chapter Nine. The next chapter, Chapter Eight, presents the results of the analysis of the lecturer semi-structured interviews. Chapter Eight follows the same structure as the current chapter, with the same themes and sub-themes but with some variation in categories and codes.

CHAPTER EIGHT

LECTURER INTERVIEW RESULTS

This chapter presents the results of the lecturer semi-structured interviews, and comprises eights sections. The first section presents the demographic details of lecturer semi-structured interviews. The second section details the transciptions of the semi-structured interviews and presents a summary of the transcripts. The third section examines the in-depth coding of the semi-structured interviews transcripts. The fourth section presents the two emergent themes that emerged from the analysis. The fifth and sixth sections examine the first emergent theme, *Affordances of ICT* and its associated sub themes: *Current ICT Usage* and *Future Transformative Actions*, respectively. The seventh section examines the second emergent theme, *Challenges of ICT*. The eight section provides a conclusion to the chapter.

8.1 LECTURER SEMI-STRUCTURED INTERVIEW - DEMOGRAPHICS

As described in the research plan, ten semi-structured interviews were to be conducted. However, equal male and female representation was not possible because there were only three female lecturers available to take part in the interviews. To maintain the planned ten interviews, seven rather than five male lecturers were interviewed. All participants interviewed had ten years or more experiences in teaching various subjects, such as mathematics, ICT, science, librarianship and language, both in schools and at the college (both English and Dzongkha). The majority had either taught or were teaching across all year levels of the Bachelor of Education programmes at the college. Table 8.1 presents the relevant demographic details of the semi-structured interviews.

Table 8.1. Demographic details of the lecturer semi-structured interviews

Lecturer	**Sex**	**Teaching areas**	**Teaching experience (Years)**
Lecturer 1	Male	English	24
Lecturer 2	Female	Library	15
Lecturer 3	Female	English	27
Lecturer 4	Male	History and Social studies	15
Lecturer 5	Male	Mathematics and ICT	18
Lecturer 6	Female	Science	17

Lecturer	Sex	Teaching areas	Teaching experience (Years)
Lecturer 7	Male	Counselling	20
Lecturer 8	Male	Dzongkha	16
Lecturer 9	Male	Mathematics	23
Lecturer 10	Male	Science and Mathematics	20

8.2 TRANSCRIPTION AND SUMMARY OF SEMI-STRUCTURED INTERVIEWS

In this section the procedure for transcription of the interview data and the preliminary analysis of the interview are presented.

8.2.1 Interview Protocol

To review, the lecturer semi-structured interviews were conducted in accordance with the protocol described in Chapter Four to facilitate a responsive and successful interviewing process. The interview questions comprised nine broad seed questions (see, Figure 4.2) with linked strategies to probe for deeper responses.

8.2.2 Transcription

The ten semi-structured interviews were transcribed and summarised employing a basic content analysis procedure linked to the interview questions. The purpose of these summaries was to allow the researcher to familiarise himself with the data. An overall summary of the ideas in the data is presented next to provide an overiew of the interview proceedings.

8.2.3 Overall summary of transcripts

The summaries were condensed and the content was classified utilising the following seven ideas based on the seed interview questions: *Common ICT tools used by lecturers, Lecturer current practice of using ICT*, *Lecturer perceptions of ICT*, *Support in using ICT*, *Impacts of ICT on GNH values*, *Impediments to using ICT,* and *Conditions necessary for using ICT.*

Common ICT tools used by lecturers

Lecturers reported using different types of ICT tools that fell under four categories: hardware, software, Internet, and Apps. The hardware comprised computers, laptops, iPads, and mobile/smart phones. The main software used by the lecturers were word

processors, spreadsheets, and PowerPoint. In the classroom, PowerPoint was the most commonly used ICT tool. Lecturers reported that the Internet was widely used and for them was a primary source of teaching and learning resources. Lecturer use of the Internet included web tools such as blogs, Google Docs and social networking tools. The most extensively used social networking tool was Facebook. Additionally, the college's Virtual Learning Environment (VLE), Moodle, was used by the lecturers primarily for academic purposes. Lecturers reported using different Apps such as Viber, WeChat, WhatsApp, and Skype, primarily for communication purposes.

Lecturer current practice of using ICT

The lecturers reported that they used different types of ICT in their teaching. They reported that the Internet was their primary teaching resource, used extensively as it offered different web tools and platforms beneficial to their day-to-day teaching. In this context, the Internet was discussed as a common "tool". In the classroom, traditional writing on the chalkboard has been almost replaced by PowerPoint presentations because these are convenient and efficient in terms of up-to-date resources required for teaching and learning. Lecturers reported that the social networking tool Facebook was widely favoured by the lecturers, but only a few indicated that they used it for pedagogical purposes. Some lecturers reported that they used weblogs and Google Docs for academic purposes and that Apps were occasionally used for communication purposes with colleagues and pre-service teachers. Lecturers pointed out that it is mandatory for all lecturers to use the college Moodle for teaching. However, Moodle is used mainly for making official announcements and uploading resources, such as reading materials, term and lesson plans.

Lecturer perception of ICT

Lecturers reported that ICT is very beneficial for their day-to-day professional work. They said they use ICT because it is a great resource for teaching, is more sustainable with respect to resources, makes teaching more efficient, effective, and interactive, and makes communication and sharing of resources more convenient. Lecturers believed that using ICT to support pre-service teacher learning helped to make the learning enjoyable, engaging, collaborative, motivating, and empowering. Lecturers believed using ICT made learning more flexible enabling independent learning opportunities that go beyond the classroom. Lecturers believed that ICT provides knowledge construction tools that helped create learner-centered teaching and accelerated student learning. uUsing ICT, such as blogs and online forums, helps those shy pre-service

teachers, who are not able to participate actively in a face-to-face classroom teaching, thereby overcoming some of their anxiety. Lecturers believed that using ICT has the potential to enhance student creativity and critical thinking abilities, and enhance GNH principles and values.

Support in using ICT

The lecturers reported that the college provides them with a laptop, access to WiFi infrastructure and different types of support. Lecturers indicated that they are provided with some professional development on ICT skills but professional development related to pedagogical knowledge has not been provided. Lecturers reported that they are mandated to utilise the college-provided Moodle platform as the VLE to support the delivery of their lessons.

Impact of ICT on GNH values

Only a few lecturers mentioned that they teach GNH values while others believed it is not necessary to teach GNH values specifically. Overall, all lecturers believed that at least some GNH values are being unintentionally taught in their lessons. Additionally, all the lecturers felt that GNH values should be taught to pre-service teachers. Lecturers all believed that ICT can be used as a tool to effectively inculcate GNH values such as: sustainability, time use, creativity, problem solving, critical/analytical thinking, respect, and sharing.

Impediments to using ICT

Lecturers reported four barriers to using ICT at the college. First, the slow Internet speed makes it difficult for them to use the online resources that they depend on for their teaching. Second, lecturers are restricted in what they are able to do by a lack of skills including the technical skills required to use different types of ICT and the pedagogical skills needed to use ICT effectively in teaching. For example, due to lecturers' lack of both technical and pedagogical skills for using ICT, they mainly use PowerPoint presentation which as the effect of making their teaching lecture-driven. Third, the college rule that does not allow pre-service teachers to use mobile/smart phones and social networking tools during class hours was thought by lecturers to be hindering their abilities to use ICT with pre-service teachers. Fourth, lecturers reported that many pre-service teachers are not able to own personal ICT. This restricts pre-serivce teachers' use of ICT and may give unintended advantages to those who are able to own ICT, thus creating an equity issue.

Conditions necessary for using ICT

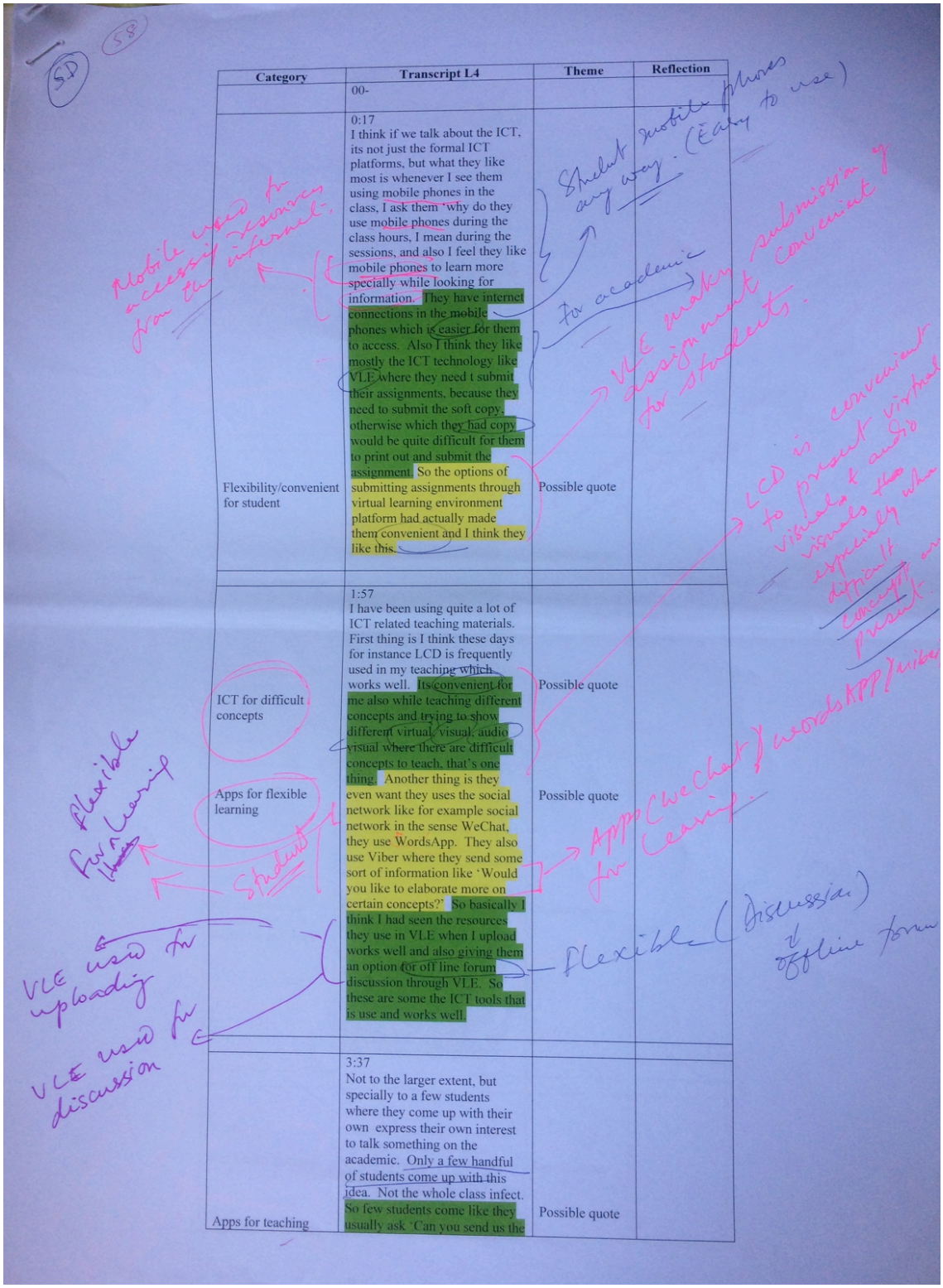
Lecturers identifed three conditions necessary for using ICT effectively in their teaching. First, improving the speed of the Internet lecturers thought would be good as they mainly depend on the Internet for their teaching resources. Second, lecturers believed providing them with greater opportunities to upgrade their ICT skills would help them to improve the effectiveness of their ICT use. Third, lecturers reported that providing professional development opportunities in the use of pedagogical use of ICT would help them enhance their abilities to use ICT for effective teaching.

8.3 IN-DEPTH CODING OF TRANSCRIPTS

Following the Braun and Clarke (2006) thematic analysis procedure, in-depth coding of the transcripts was carried out. As with the pre-service teacher focus group interview data analysis, prior to the actual coding, all the interview transcripts were read and summarised (presented in previous section) in order to become familiar with the data.

8.3.1 Coding Process

The ten lecturer interview audio recordings gathered through semi-structured interviews were analysed using the six phases of thematic analysis proposed by Braun and Clarke (2006): *Familarisation with data; Coding; Searching for themes; Reviewing themes; Defining and naming themes; and Writing up*, as described in Chapter 3. As for the pre-service teacher focus group interview data analysis, the text of the transcripts was arranged in a table with four columns: *category, transcript, theme,* and *reflection*. Part of the coding table is shown in Figure 8.1. The handwritten annotations represent the steps taken to initially identify codes. Relevant information from the later phases, to decide on categories and themes, were added in the relevant columns during this process.



Category	Transcript L4	Theme	Reflection
	00-		
Flexibility/convenient for student	0:17 I think if we talk about the ICT, its not just the formal ICT platforms, but what they like most is whenever I see them using mobile phones in the class, I ask them 'why do they use mobile phones during the class hours, I mean during the sessions, and also I feel they like mobile phones to learn more specially while looking for information. They have internet connections in the mobile phones which is easier for them to access. Also I think they like mostly the ICT technology like VLE where they need t submit their assignments, because they need to submit the soft copy, otherwise which they had copy would be quite difficult for them to print out and submit the assignment. So the options of submitting assignments through virtual learning environment platform had actually made them convenient and I think they like this.	Possible quote	
ICT for difficult concepts Apps for flexible learning	1:57 I have been using quite a lot of ICT related teaching materials. First thing is I think these days for instance LCD is frequently used in my teaching which works well. Its convenient for me also while teaching different concepts and trying to show different virtual, visual, audio visual where there are difficult concepts to teach, that's one thing. Another thing is they even want they uses the social network like for example social network in the sense WeChat, they use WordsApp. They also use Viber where they send some sort of information like 'Would you like to elaborate more on certain concepts?' So basically I think I had seen the resources they use in VLE when I upload works well and also giving them an option for off line forum discussion through VLE. So these are some the ICT tools that is use and works well.	Possible quote Possible quote	
Apps for teaching	3:37 Not to the larger extent, but specially to a few students where they come up with their own express their own interest to talk something on the academic. Only a few handful of students come up with this idea. Not the whole class infect. So few students come like they usually ask 'Can you send us the	Possible quote	

Figure 8.1. Part of coding table used for the coding process

For the first phase, *Familarisation with data*, all transcripts were read whilst listening to the audio recording to become familiar with the data and capture nuances that may have been lost in the transcription process. As for the pre-service teacher semi-structured interviews (see, Chapter Seven), reading transcripts and listening to the

audio recordings at the same time enabled the researcher to immerse himself in the data and begin to explore relationships before coding commenced. For the second phase, *Coding*, the transcripts were read and re-read to generate codes which were assigned using words, phrases, and/or short sentences. These codes were identified and recorded in the code column of the coding table. Possible representative quotes were identified and recorded in the table by highlighting relevant words. As explained in the previous chapter, this coding of the lecturer semi-structured interview data was undertaken in parallel with the coding of the pre-service teacher interview data. This was done because initial reading of the transcripts indicated sufficient similarity to justify analysis in parallel.

As previously for the pre-service teacher focus groups, two of the researcher's thesis supervisors each coded the data separately and the resulting coding was compared with the coding produced by the researcher. All parties then individually re-coded the data using this set of agreed code descriptions and through an iterative process of consensus, the final codings were developed. The researcher then revisited the transcripts and re-coded according to these new agreed code descriptions. Again, as previously, the identification and description of the emergent themes employed this same iterative process of consensus. In all, 32 different codes were identified and these are named below in the description of the themes.

8.3.2 Categories

Upon completion of the iterative re-coding process, the codes were analysed and grouped to generate categories to capture the inherent meanings in each transcript. As for the pre-serivce teacher focus group interviews, an iterative process of reading transcripts, suggesting categories, re-reading transcripts and reviewing categories was performed of times to generate a suite of agreed categories and description for each category. The eight categories identified were: *Access, Affective state, College policy, Communication, Environment, Planning, Skills,* and *User characteristics*. This is one more category than was identified for the pre-serivce teacher focus group interview data. The extra category is *Planning*, which the pre-service teachers did not mention because it was not relevant for them. Description of the themes that were developed follows.

8.4 PROCESS TO REVEAL EMERGENT THEMES

For the third phase, *Searching for themes*, the eight categories were analysed in order to identify storylines and themes present across the 10 transcripts. As with the pre-service teacher focus group interview data analysis, the first step in the analysis to assist in the identification of themes involved the process of grouping categories, and their linked codes that shared similar features. Next the researcher, in conjunction with the supervisory team, proposed, examined and debated emergent themes. The process resulted in the identification of two robust themes: *Affordances of ICT* and *Challenges of ICT*. These two themes are described in detail below.

8.4.1 Affordances of ICT

The first theme, *Affordances of ICT*, has six categories and 25 associated codes (Table 8.2). As was defined under section 7.5, affordances of ICT is defined as the beneficial aspects of ICT in teaching and learning. This theme is made up of two sub-themes - *Current ICT Usage* and *Future Transformative Actions*, which represent two dimensions, current practice and future practice. The sub-theme *Current ICT Usage* represents current practice and mainly includes the beneficial aspects of lecturer use of ICT in day-to-day teaching. The sub-theme *Transformative Actions* represents future practice as the potential to change teaching and learning when using ICT tools, such as computers, laptops, iPads, mobile/smart phones, Apps, and web tools. The six categories in Table 8.1 are the five categories identified for the pre-service teacher focus group interview data (see Table 7.1) with the addition of one more category *Planning*. As far as codes are concerned, there were five new codes that appeared in the lecturer semi-structured interview data analysis, that did not appear in the pre-service data analysis, and there was one code from the pre-service data analysis that did not appear in the lecturer data analysis. The five new codes were: *flexible*, *knowledge creation*, and *situated learning* in the *Environment* category; and *learning environment* and *pedagogy* in the *Planning* category. The one code that did not appear in the analysis was *restrictions* from the access category, within the pre-service teacher data.

Table 8.2. Theme: Affordances of ICT - associated categories and codes

Category	**Code**
Access	Availability Equity
Affective states	Engaging Enjoyable Motivating

	Overcoming anxiety

Category	**Code**
Communication	Collaboration Connectedness Interaction Sharing
Environment	Authentic Convenience Customisation (Creativity) Efficient Empowerment Flexible Innovative Knowledge creation Relevant Situated learning Transformative
Planning	Learning environment Pedagogy
User characteristics	Learning styles Self-directed

8.4.2 Challenges of ICT

The second theme, *Challenges of ICT*, is defined as those elements that act as barriers to the lecturer being able to make use of ICT. This theme comprises three categories and seven codes (Table 8.3). As far as codes are concerned, there was one new code *pedagogy*, in the *Skills* category, that appeared in the lecturer semi-structured interview data analysis, that did not appear in the pre-service data analysis.

Table 8.3. Theme: Challenges of ICT - associated categories and codes

Category	Code
Skills	ICT Pedagogy
Access	Internet bandwidth Computers Wi-Fi facilities
College policy	Restrictions on hardware usage Restrictions on Internet usage

Detailed descriptions of each category, including quotes from the lecturer interviews, follows, first for each of the two subthemes of the theme *Affordances of ICT*, then for the theme *Challenges of ICT*. As foe the pre-service teachers the direct quotes from lecturers, presented in this chapter, may not be grammatically correct as the text has come in the form of conversation as typically expressed by Bhutanese people.

8.5 THEME: AFFORDANCES OF ICT; SUB-THEME: CURRENT ICT USAGE

The Current ICT Usage affordances of ICT are reported under the six categories: *Access, Affective states, Communication, Environment, Planning, and User characteristics*, as presented in Table 8.1.

8.5.1 Category: Access

Access is defined as those factors that determine the lecturers' ability to utilise ICT for different purposes. Within this category there were two codes: *availability*, and *equity*. Compared to the pre-service teacher data analysis for this sub-theme and category, the *restrictions* code did not appear in the coding, but the new code *equity* did. *Availability* includes the notion of whether ICT is available or not available, and whether it is allowed to be used, or not allowed to be used. The affordances of ICT are dependent on whether lecturers have access to different ICT and ICT infrastructure. ICT infrastructure includes access to hardware, software, Internet connections, and Apps. In order for lecturers to leverage the full potential of ICT, access to quality ICT infrastructure is a must, as indicated in:

> So to me, with good ICT facilities means they can have good output and good output means they can achieve the philosophy of GNH in terms of teaching, in terms of learning, in terms of sharing and bringing a change in a society and the society change will be a great change if they bring a change in the ICT (Lecturer 4).

Some of the potential affordances of ICT are impeded by the lack of access to quality ICT infrastructure, in particular, slow Internet speed makes it difficult to work which is reflected in a comment by Lecturer 4: "but at times when there is poor connectivity of networks or poor Internet speed, we find it vey difficult to work with what they are supposed to do". Lecturers think that improving such infrastructure has immense benefits, particularly for pre-service teachers as Lecturer 5 indicated: "sometimes they will have Apps like some students have laptops, personal computers. So if they are in the dormitories it would be very useful if they could access Internet".

Lecturers reported that access to suitable hardware is more problematic for pre-service teachers than for themselves. Lecturers also reported that pre-service teachers are more advanced users than they are but that access to suitable hardware is more problematic

for pre-service teachers than for themselves. This is an issue of equity where those with personal ICT are likely to be at an advantage compared to others as demonstrated by Lecturer 9:

> Well I think this is a challenge in Bhutanese classroom, especially those who have the device are well informed, more informed. But as an academic we should be more careful like those people who do not possess such device lack certain information.

The lecturers thought it necessary to pay attention to such an equity issue, where potentially some of the pre-service teachers would receive an obvious advantage over others because they are in a position to own their own ICT.

8.5.2 Category: Affective states

This category includes those elements associated with emotional and psychological benefits of using ICT. Within this category there were four codes: *engaging*, *enjoyable, motivating*, and *overcoming anxiety*.

Using ICT according to lecturers, aids them in enhancing pre-service teacher in learning. Using ICT at different stages of lessons, such as lesson introduction or learning activity stage, is seen as an effective engaging use of ICT. One example shared by Lecturer 6 on how the use of projectors are able to engage students: "especially LCD projector uhm so that I can involve the learners at different times of my lesson".

Using ICT can engage pre-service teachers with stimulating tasks - "But if we want to use ICT, we can do more than that. We can set up some challenging task for them. We can also embed some materials in their teaching and learning" (Lecturer 8). Another example of engaging learning experiences, this time related to Moodle usage, was shared by Lecturer 4:

> Yeah, when we use these virtual learning environment, they see lot of features, this … that it has not only the features like which they can have group discussion but there also have live chat then discussion and then these things it motivates them to learn, discuss and then post questions for clarification and then not only get responses from tutors but they also seek responses from colleagues.

Lecturers reported that ICT enables teaching to be synchronously or asynchronously delivered. Unlike traditional methods of teaching, the modern teaching method where

ICT is used, not only makes lessons enjoyable for pre-service teachers but also engages them beyond the four classroom walls. For example, involving pre-service teachers in asynchronous lessons makes lessons enjoyable for them especially the introverted ones because in asynchronous lessons they are better engaged and are more motivated to learn as evident in:

> I would like to share this … the moment we share something online becomes less formal and when it is less formal I have seen the even the non active students in the class participate in the class quite actively and students express more freely and somehow they seemed shed off their inhibitions when they are online as opposed to they are in the class (Lecturer 2).

One comment by lecturer 9 corroborates the above statement: "This helpful because those students who cannot speak in the class they come up with lot of questions in the offline forum".

The asynchronous discussion made possible by ICT not only engages pre-service teachers but also provides them with opportunities to reflect and discuss as reported by Lecturer 5: "But then when there is nobody they are able to express, they have the freedom to think and then put down into writing".

This type of active engagement with ICT is also shown to be a motivating factor for pre-service teacher learning as Lecturer 8 reported "… I derive their motivation and readiness to learn. So using it in this this way that I integrate ICT in teaching and learning".

Interactive multimedia also has the ability to act as a motivational tool for pre-service teacher learning as compared to the more traditional methods of teaching and learning, as Lecturer 4 reported:

> Ah to me traditional tools its to our students at this age, this period they find it bit I would say boring, its bit stagnant but when we try and use ICT they get motivated because the things we see are dynamic and then they see things which they don't see in traditional ways of using but ICT saves time.

8.5.3 Category: Communication

This category is defined as the mode of interaction among pre-service teachers, lecturers, and parents that can be either formal or informal. ICT is seen as a tool that facilitates numerous types of communication to enable both lecturers and pre-service teachers to interact, collaborate, share, ask questions, and stay connected. Within this category there were four codes: *collaboration, connectedness, interaction,* and *sharing*.

Lecturers reported that both lecturers and pre-service teachers interact using ICT tools. Lecturers considered ICT as an important tool for pre-service teachers as it enables both lecturers and pre-service teachers to collaborate, share ideas and resources as Lecturer 8 explained: "The main purpose of using these tools are I want my students to interact among themselves and to make meaning of their own through discussion, through sharing ideas". Such an interactive and collaborative platform, enabled by ICT, is perceived as something that is inspiring to pre-service teachers as indicated by Lecturer 1: "ICT definitely does make our teaching learning more interactive more stimulate, the students are stimulated definitely". Lecturers believed learning becomes particularly interactive when online tools are used in their teaching as "with the online study because sometimes it becomes interactive when we do the online study and then … and then even the learning becomes meaningful in one's life" (Lecturer 5). One example of interactive and collaborative learning affordances of ICT is the use of social tools that are familiar to pre-service teachers:

> Yea as I mentioned earlier … on the Facebook we prepare, make groups and we … you know ... what we sign in and we start discussion forum there. That's quite handy and I believe there are so many you know can create but I have tried with Facebook and most of my students seem to familiar with that one (Lecturer 2).

Social tools and other free Apps are considered exceptionally useful communication tool for the lecturers because these tools facilitate communication at no additional cost which helps improve lecturer and pre-service teacher relationships:

> And like I am just thinking in terms of communication, a very free kind of communication that is happening, letting the teacher and students communicate freely and then that kind of relationship where children can express their thoughts, their emotions, a teacher responding to that or a student responding to that (Lecturer 5).

Lecturer 2 provided the specific example of the use of free applications which lecturers think helps to maintain relationships and stay connected with their friends and family members:

> For instance, we take an example of families overseas. You could use Viber and call endlessly for free and you could use Skype, you could use video call on the Facebook and meet any other or you know family members as if they are together.

8.5.4 Category: Environment

Environment is defined as the ability to create conditions and context through the use of ICT by the lecturers to transform their teaching. Within this category there were 11 codes: *authentic, convenient, customization (creativity), efficient, empowering, flexibility, innovative, knowledge creation, relevant, situated learning,* and *transformative.* Compared to the pre-service teacher data analysis for this sub-theme and category, three new codes appeared: *flexible, knowledge creation,* and *situated learning*.

For the environment created due to the affordances of ICT, lecturers identifed three key points. First, lecturers reported that the environment created because of the affordances of ICT creates avenues where learning is authentic, innovative, relevant, and creative where pre-service teachers are encouraged to use higher order skills. Lecturer 8 indicated that using ICT creates an authentic and innovative teaching and learning environment for pre-service teachers:

> For example, if they have prepared a powerpoint how to share that PowerPoint in Facebook. Straight away we cannot upload the PowerPoint in Facebook, that is not possible. So we have to use some other tools. So we explore in and we found out that and its quite challenging and quite useful at the same time.

Lecturer 5 corroborated the above claim and indicated that such an environment improves pre-service teacher learning: "I am thinking this will really improve their learning because nowadays different Apps have come and then very educational kind of Apps like putting down their thoughts and linking."

Second, lecturers reported that ICT enabled learning environments are prefered by pre-service teachers because such learning environments are convenient, efficient, flexible, and empowering. These claims were observed by Lecturer 2: "So, that gives them

liberty, … that gives them freedom to choose on their own". A similar opinion was expressed by Lecturer 4: "So using ICT I think they learn their own things and take care of all those learning materials which they need to carry out throughout the semester or year". An even stronger assertion was provided by Lecturer 8: "..its not necessary that we have to meet at one point of time on same place because when we use ICT it can be asynchronous as well as we can have synchronous discussion online".

Third, lecturers claimed learning is transformative in an ICT enabled learning environment because in such an environment lecturers are able to engage pre-service teachers actively with hands-on activities where knowledge creation is encouraged as indicated by Lecturer 1: "I also saw you know movie making, small clips in some projects. It's a module. I saw them just going round and shooting a story and bring back and it has a theme". This situated learning affordance enabled by ICT makes teaching of some abstract concepts much easier to convey to the pre-service teacher through the use of simulation software as Lecturer 3 reported:

> And then once it is done what happens is … suppose if I have to toss the same coin one hundred times, then it takes lot of time but then once they have this concept of idea of tossing coins and then they know how to calculate the probability of getting a head or a tail then if I say suppose if I toss the same coin million times, it is not possible for them. So but what happens with ICT tool once we get this virtual manipulatives we just have to say million toss and then it in a matter of few seconds or few minutes it gives us the result.

8.5.5 Category: Planning

Planning is defined as the process where lecturers plan, design, and implement instruction. The affordances of ICT mean that lecturers can use ICT to inform themselves about how best they can make their instructional practices effective and efficient using the ICT tools. Within this category there were two codes: *learning environment,* and *pedagogy*.

Lecturers reported three benefits that enabled them to plan their instructional practices at the college. First, the affordances of ICT enabled them to plan lessons and activities that resembled the real world setting as depicted by Lecturer 1: "These are I think real-life materials they can be very effective in teaching and learning and ICT is doing that facilitating that ... I think it's a good thing". Lecturers reported that using ICT allows

them to plan instructions that they believe cannot be done without using ICT, "I think there is huge role and I think specially in science and other fields where it is not possible without ICT, without audio visuals, I think it has a huge impact because we can do simulation we can do so many things that is not possible with traditional tools" (Lecturer 3).

Second, lecturers believed that planning using ICT transformed the learning environment for pre-service teachers, and helped lecturers to transform and enhance their pedagogy. Teaching and learning is more flexible with ICT such as the college Moodle, social networking tools, and free communication applications where lecturers are able to teach from anywhere and pre-service teachers are able to learn from anywhere and at anytime:

> And then this virtual learning environments as a common learning platform where everybody can ask questions, clarify, and then they can get things clarified using that virtual learning environment. They need not physically come and meet tutor or lecturer or they do not have to go friends go to a friend's place and sort those things (Lecturer 4).

Third, as the affordances of ICT helped lecturers transform the learning environment and their pedagogical practices, they believed they are able to enhance their assessment practices as well. ICT made assessment procedures more flexible as Lecturer 4 reported:

> They use social network and ICT technologies for communication and sharing their files as well as in terms of preparing their assessments and presentations and they do use and they use features not sitting together but they work and then sit under different places but virtually they work together.

8.5.6 Category: User characteristics

User characteristics is defined as the style of teaching lecturers adopt when using ICT. Within this category there were two codes: *learning styles,* and *self-directed learning*.

Lecturers reported that when using ICT they are able to design their teaching in accordance with the view that pre-service teachers learn differently. They mentioned that some pre-service teachers are visual learners while others require an adequate amount of time and space to reflect. Lecturer 5 demonstrated such affordance of

lecturer ability to use ICT that enhances practice through the design and implementation of lessons by considering different pre-service teacher learning styles:

> So I still use it because you know sometimes children are visual learners and when I write down the important points on the board they seem to be connected with what is being taught in the class because they see those important concepts being written on the board and it gives them a kind of connection to keep them into learning whatever I am teaching.

Lecturers reported that ICT provided a certain degree of flexibility in pre-service teacher learning which goes even beyond the bounds of the classroom or college. One example of this is:

> Um … I … students ..one thing students dread especially in the class is face to face contact with monotonous lecture and using these different tools, assigning them task and coming for discussion online something that I have used and found it quite useful and students enjoy that instead of having to come personally and listen to long lectures (Lecturer 2).

Lecturers reported that the affordances of ICT creates avenues for self-directed learning opportunities for pre-service teachers where the learners become more independent as indicated by Lecturer 4: "So this is which we have seen and then students they become more independent learner using ICT. They are no more dependent on somebody who feeds the information".

8.6 THEME: AFFORDANCES OF ICT; SUB-THEME: FUTURE TRANSFORMATIVE ACTIONS

The Future Transformative Actions affordances of ICT are reported under the six categories: *Access, Affective state, Communication, Environment, Planning, and User characteristics*, as presented in Table 8.2.

8.6.1 Category: Access

Access is defined as the different types of ICT infrastructure that lecturers have the potential to utilise in the future. Within this category there were two codes: *availability, and restrictions.*

Better availability of ICT, lecturers thought, would be beneficial in two ways. First, having access to ICT could enable them to use a wider range of resources, particularly

teaching and learning resources as reflected in Lecturer 10's statement: "and another advantage could be like we have more access to resources not just Googling like that, but we can use online journals as well".

Second, availability of ICT could transform a lecturers' teaching methods, as Lecturer 1 explained: "Yes I would like to add that the more I talk about ICT I feel that ICT has done a lot. It has in a way changed the way we conduct classes in the class". Using ICT they believed could complement traditional teaching method, as some lesson concepts are more efficiently delivered over traditional method while others are better delivered with modern teaching using ICT:

> But then once they have the concept, then if use ICT tools then it helps them to explore further and learn more. So I think merging of two for me especially in my classroom. I find merging of these two tools together have great advantage than teaching them in isolation (Lecturer 3).

Lecturers believed that the use of ICT could make teaching and learning more convenient because both lecturers and pre-service teachers are surrounded by different ICT which could be used to enhance teaching and learning. For example, Lecturer 8 reported: "… and our students are using their mobile phones to capture some video clips so that it authenticate their presentation". According to lecturers, access to ICT assists their ability to teach in any location, for example, "teaching when you are not here in the college. That's one thing I think some faculty use I have seen and I use also" (Lecturer 9).

8.6.2 Category: Affective states

This category is defined as how using ICT could create an enabling and transformative environment resulting in emotional and psychological satisfaction. Within this category there were four codes: *engaging, enjoyable, motivating,* and *overcoming anxiety*.

Lecturers reported that using different ICT tools such as computers, laptops, iPads, smart phones, web/social networking tools, college LMS, and other free applications could create engaging, challenging, and enjoyable learning environments. Such transformative potential as described by Lecturer 5:

> I have realised that our students like to communicate with their teacher using ICT because sometimes I have noticed that there are students who are not very open in the classroom, and then they are not able to voice out

> because they have that fear. So when I use the ICT I have seen that they open up and they share what is in their mind and it gives them sense of security when they use the ICT and then I have noticed that they are more willing to share with the ICT their problems.

Lecturers indicated that enjoyable and engaging learning affordances of ICT could boost pre-service teacher motivation to learn, particularly in a networked learning environment as such environments can help pre-service teachers overcome their anxiety. To demonstrate:

> But I use more VLE sir especially the offline activity. I leave like for example, I had a class this morning, then I leave the option for offline discussion in the VLE. This is helpful because those students who cannot speak in the class they come with lot of questions in the offline forum (Lecturer 9).

Lecturer believed real time interaction made possible by ICT affordances could also boost pre-service teacher motivation to learn as they would be able to participate in discussion in real time: "features like which they can have group discussion but they also have live chat then discussion and then this things it motivates them to learn, discuss and then even post questions for clarification" (Lecturer 4). The possibility of enhancing pre-service teachers' motivation to learn is also indicated by Lecturer 1: "ICT definitely does make our teaching learning more interactive more stimulate, the students are stimulated definitely". One lecturer indicated that using ICT could motivate pre-service teacher learning because they have fast access to up-to-date resources: "I think ICT has a potential to boost the morale of the students in terms of speed … ah and currency of information" (Lecturer 6).

8.6.3 Category: Communication

Communication is defined as the use of any ICT tools in which collaboration, cooperation, and interactions could take place. Within this category there were three codes: *collaboration, connectedness,* and *sharing*.

The communication affordances of ICT, lecturers thought, could transform both formal and informal collaboration. They indicated that the communication affordances of ICT would greatly transform their abilities to collaborate where resources and ideas could be efficiently shared: "… and there are some topics that need a kind of collaborative

learning. So I just post a question and all the students get into the forum and they answer, they question" (Lecturer 5).

Lecturers indicated that social networking tools such as Facebook, Wikis, and other Apps have the potential to enhance communication resulting in changing the way they teach as reflected in:

> The main purpose of using these tools are I want my students to interact among themselves and to make meaning of their own through discussion, through sharing ideas, not necessarily that I have to teach them what things are there in the module (Lecturer 8).

Lecturer 10 also indicated that communication affordances of ICT makes sharing of teaching resources among colleagues and pre-service teachers possible: "Ok I think the use of VLE like lecturers like to post on VLE their PowerPoint presentation, even their term plans and resources they like to share to the students". This was corroborated by Lecturer 3: "and like all other materials like audio, visual everything that needs to be uploaded we upload in the VLE and then they download it and they use it".

Lecturers reported that the communication affordances of ICT have the potential to transform informal communication abilities that helps to keep them connected to their colleagues, family, and friends. For example,

> I think this tool had made life more easy. I think this is also part of GNH la because that is community vitality we talk about which is one of the GNH values. Community vitality and ICT has boosted this community vitality. It has enabled the people to come closer and the get things addressed at a quicker time (Lecturer 6).

Such communication affordances of ICT, according to lecturers, could aid in providing emotional satisfaction because everybody could express themselves openly, without hesitation, resulting in improved relationships with others including pre-service teachers and colleagues. For example,

> And like I am just thinking in terms of communication, a very free kind of communication that is happening, letting the teacher and the students communicate freely, and then that kind of relationship, developing the relationship using the ICT, a kind of relationship where children can express their thoughts, their emotions, a teacher responding to that. And then it's a connection I think though there is no physical connection, but so

> much of emotions are involved in that and it really develops that connection (Lecturer 5).

Lecturers indicated that social networking tools and different Apps they are able to access over the smart phones and portable devices could transform the nature of their communication, particularly for staying connected with family and friends. For example,

> For instance, we take an example of the families living overseas. You could use Viber and call endlessly for free and you could use Skype, you could use video call on the Facebook and meet any other or you know family members as if they are together (Lecturer 2).

8.6.4 Category: Environment

Environment is the setting that could be created by the utilization of ICT tools that has the potential to change the nature of and the approaches to teaching. Within this category there were ten codes: *authentic, convenient, customization (creativity), empowering, flexible, innovative, knowledge creation, relevant, situated learning,* and *transformative.* Compared to the pre-service teacher data analysis for this sub-theme and category, three new codes appeared: *flexible, knowledge creation,* and *situated learning*.

The environment created through the use of ICT, according to lecturers, has the potential to transform the nature of teaching and learning because learning can be authentic, innovative, relevant, and empowering resulting in pre-service teachers centered teaching and learning as depicted by Lecturer 1: "It is more interactive, it can be it can be customised at anytime, it can also I think stimulate a lot of students' thinking, whereas traditional, … traditional ways using the charts, blackboard, it's the teacher has to be the know all". Lecturers indicated that such environments could enable pre-service teachers to take more responsibility for their learning where creative ideas can be generated, as reported by Lecturer 2:

> So anybody can learn anything on that subject. So, I think in the traditional system we were limited to sharing what just knew but today what we could do instead of sharing what we know in fact is … we could teach them how to learn and then let them … guide them how to go about learning on specific areas.

Finally, lecturers indicated that an ICT enabled environment could make learning more flexible because learning can take place in different places and in different ways with possibilities for pre-service teachers to explore more on what is being delivered in the classroom as indicated by Lecturer 8:

> … because when we use ICT it can be asynchronous as well as we can also have synchronous discussion online. That's the big advantage that we have and it also gives the possibility for students to explore further on their own.

8.6.5 Category: Planning

Planning is defined as how the utilization of ICT tools has the potential to bring about transformative changes to lecturers' instructional approaches. The transformative affordance of ICT is that it can inform lecturers on how to make their instructional approaches more effective and efficient. Within this category there were two codes: *learning environment* and *pedagogy*.

Lecturers reported that using ICT as a planning tool to create learning environments could enhance their pedagogy. For lecturers, the creative planning affordance of ICT makes teaching convenient and effective because ICT, such as multimedia suites, could make difficult concepts easier to covey to pre-service teachers. For example, "Its convenient for me also while teaching different concepts and trying to show different virtual, visual, audio visual where there are difficult concepts to teach" (Lecturer 9).

8.6.6 Category: User characteristics

User characteristics is defined as the style of teaching lecturers have the potential to adopt when using ICT. Within this category there were two codes: *learning styles,* and *self-directed learning.*

Lecturers reported that the affordances of ICT could provide opportunities to cater to the learning needs of pre-service teachers with different learning styles, resulting in independent learning opportunities as indicated by Lecturer 5: "so I am just thinking that ICT when they use the ICT they have enough time, they have their freedom, they have their space to think."

As use of ICT caters to the needs of pre-service teachers with different learning styles, it creates avenues for self-directed learning opportunities as indicated by Lecturer 4: "So this is one which we have seen and then students they become more independent

learner using ICT. They are no more dependent on somebody who feeds the information".

8.7 THEME: CHALLENGES OF ICT

The Challenges of ICT are reported under the three categories: *Skills*, *Access,* and *College policy,* as presented in Table 8.3.

8.7.1 Category: Skills

Skills is defined as the abilities, both ICT and pedagogical, that constrain lecturer utilization of ICT. Within this category there were two codes: *ICT* and *pedagogy*. Compared to the pre-service teacher data analysis for this sub-theme and category, one new code appeared: *pedagogy*.

One problem of using ICT for teaching, identified by the lecturers, is their lack of ICT skill. One lecturer revealed the problem: "Ya how to create stimulate it just a few not too many but related to ICT, ICT in the class because right now all we know is oh! PowerPoint, oh! PowerPoint. We think that's the world of ICT" (Lecturer 1). Lecturer 1 then went on to explain:

> I think lack of enough skills and knowledge definitely lack of skills. You want to do a lot of things but you are limited by your skills … for example, I have this desire to make interactive and stimulating PowerPoint and I don't know where to begin and and I end up with just little I know.

Lecturer 8 corroborated this:

> Specifically in technical part sir. For example, how to set up discussion forum and how to open up some topics for our students, and how to assess that. And not only that for example, if I want to use a online quiz, how to go about it So these are some of the practical issues that our friends are having at the moment.

Another problem ICT, lecturers reported, pertains to their lack of pedagogical skills in using ICT. Lecturer 8 described the challenge of pedagogy as: "They are not into it. There are so many factors that has affected their implementation of using VLE. For example, their background, then pedagogy of using ICT in teaching and learning". Lecturer 8 continued with the observation that lecturers are not able to leverage pedagogical affordances of ICT:

> So far they are used to with the face-to-face teaching where technology is not much involved or used. They feel using Powerpoint is also use of ICT, but its not really helping our students. They are just flashing the information on the board and that's it.

Lecturer 9 further indicated that professional learning was needed to develop lecturers' pedagogical skills to use ICT: "then also I think we need to give some professional training to the faculty about the ICT and then we also must make aware of awareness to the students about the ICT, the advantages of ICT, how do they use ICT for academic".

8.7.2 Category: Access

Access is defined as the challenges that lecturers have in trying to utilise different types of ICT infrastructure. Within this category there were three codes: *Internet bandwidth, computers,* and *Wi-Fi facilities*. First, all lecturers overwhelmingly reported that slow Internet speed at the college is an impediment to using ICT in their day-to-day work. Lecturer 2 explained that, "from the access point of view again I would like to say that when all the students are in campus its frustrating. There we have it but we really don't have efficient Internet system for instance. That's frustrating". This lecturer continued:

> And when the internet is low it is very slow we cannot get access to it and what happens then is we land up taking yellow notes to our class which is really bad, which really is not a very good modelling for our students.

In particular, Lecturer 3 specifically identified poor internet bandwidth as an important problem: "Like suppose just now sir as simple as bandwidth you because sometimes we really want to do something else but then even the bandwidth does not support" (Lecturer 3).

Second, lecturers reported that pre-service teachers had limited access to computers and this problem indirectly impacts the lecturers' teaching. Lecturers do not face problems with access to hardware because they are provided with a laptop but the inadequate pre-service teacher-computer ratio plays an indirect role in lecturer ability to teach with ICT. Such a challenge is reflected in Lecturer 4's statement: " …. but comparing to students in the college, and the number of equipments we have , I think like that accessibility point is thought on of the barriers for students to use ICT". Another lecturer corroborated this claim: "since the number of pre-service teachers are

increasing every year, it is imperative that the number of computers in the labs need to be increased as well as to improve the accessibility of computers" (Lecturer 7). So while lecturers do have issues with access to hardware infrastructure, the problem caused by pre-service teacher lack of access impacts lecturer teaching as well.

The college provides ICT infrastructure such as the Wi-Fi connectivity within the campus. However, the challenge is that the Wi-Fi signals are weak at many locations within the campus, including the hostels where the pre-service teachers live and study. As a consequence, the poor functioning of the Wi-Fi indirectly impacts teaching. One lecturer shared the frustration: "Then coming to the infrastructure of ICT our sometimes … our infra-structure does not support what we want" (Lecturer 3). One lecturer specifically described the poor Wi-Fi facilities at the hostel: "And sometimes they have Apps like some students have laptops, personal computers. So if they are in the dormitories it would be very useful if they could access Internet" (Lecturer 5).

8.7.3 Category: College policy

College policy is defined as the rules and regulations that the college has about using ICT at the college which challenge the use of ICT in teaching. The college rules have certain restrictions when it comes to using ICT. These rules generally do not have a direct bearing on lecturer teaching but these rules do have some indirect impact. Within this category there were two codes: *restrictions on hardware usage*, and *restrictions on Internet usage*.

First, lecturers reported that hardware, such as smart phones, are not allowed to be used during class time. They mentioned that allowing the use of smart phone/mobiles causes disturbances in the classroom, for example, Lecturer 1 reflected: "… because for example if a faculty is in the class … as just enters the class, you hear mobile phone ringing … cell phones ringing … the teacher gets very annoyed…very irritated you know this is definitely not the right way to respond to such situations". Additionally, Lecturer 10 reported that although devices such as mobile/smart phones are useful to pre-service teacher learning, phones are not allowed in the classroom: "Yes, they do have, but during class hours they don't bring. Phones are not allowed". However, lecturers did agree that allowing students to use their smart phones in the class has some advantages in their teaching. For example, Lecturer 5 explained:

> And one girl just raised her hand and said, Madam I have the mobile, can I just look at the mobile. So she used the Internet and she just came up with

> the image of bean bag, and we just kept it on the table and everybody had come and had seen the image of the bean bag how it looked like.

Second, lecturers reported that difficulty in using ICT is related to restrictions imposed on certain web applications, which can impact indirectly on teaching. This particularly pertains to the blocking of social networking sites such as Facebook. Lecturers believe that social networking tools have benefits to students learning but the ICT administrators block those sites. This challenge is shared by Lecturer 6: "They don't see the web site they don't get. Access denied or something like that ANI ZUM (like that)".

8.8 CHAPTER CONCLUSION

This chapter presented the results of the lecturer semi-structured interviews. From thematic analysis two major themes emerged: Affordances of ICT and Challenges of ICT. The theme Affordances of ICT is made up of two sub-themes, Current ICT Usage and Future Transformative Actions. As with the pre-service teacher focus group interview data analysis results, codes resulting from the analysis sometimes varied for any particular category, across the themes and sub-themes. These themes and sub themes are carried over and discussed more fully in the next chapter, Chapter Nine, which presents discussion based on the results from Chapters Five, Six, Seven, and Eight.

CHAPTER NINE

DISCUSSION AND CONCLUSION

This final chapter brings together and discusses the quantitative survey and qualitative interview results of this research. These results are viewed through the lens of two theoretical frameworks, SAMR and TPACK to explore the interplay between the quantitative results and qualitative themes. Informed by this discussion, the research questions are addressed followed by consideration of the implications for the study site, limitations of the study, and recommendations for future research.

9.1 PRE-SERVICE TEACHER PERCEPTIONS

This section provides discussion of the results from the analysis of the pre-service teacher web-based survey data. It comprises four parts: pre-service teacher attitudes towards GNH and GNH in education; pre-service teacher attitudes towards ICT in education; pre-service teacher attitudes towards ICT enhancing GNH principles and values; and pre-service teacher TPACK.

9.1.1 Pre-service teacher attitudes towards GNH and GNH in education

Predominantly, pre-service teacher attitudes towards GNH and GNH in education were highly positive, although overall pre-service teachers were not so confident that they possessed adequate knowledge of GNH principles and values (see Table 5.4). When considering sex differences, male pre-service teachers were more confident than female pre-service teachers that they possessed adequate knowledge of GNH principles and values. This result marks the beginning of a trend of male pre-service teachers consistently rating themselves higher than female pre-service teachers across all categories of the survey items.

The age of pre-service teachers was shown to have no statistically significant influence on attitudes towards GNH and GNH in education. Similarly, no statistically significant differences were found in pre-service teacher attitudes towards GNH and GNH in education on the basis of year of study. This nicely triangulates the age-related findings as the age of a pre-service teacher correlates with their year of study; younger

pre-service teachers in First Year moving through to the older pre-service teachers in Fourth Year.

However, based upon enrolment programme differences between pre-service teacher attitudes toward GNH and GNH in education did exist. Pre-service teachers enrolled in the BEd (Dzongkha) programme rated themselves higher in knowledge of GNH principles and values than pre-service teachers enrolled in the BEd (Primary) programme. This can be best explained by BEd (Dzongkha) pre-service teachers being more closely attuned to Bhutanese culture and values. BEd (Primary) pre-service teachers were shown to be more supportive of GNH being infused into their day-to-day teaching than pre-service teachers enrolled in the BEd (Secondary). Possibly, the greater discipline focus of secondary education may be what was influencing those BEd (Secondary) pre-service teachers' attitudes.

9.1.2 Pre-service teacher attitudes towards ICT in education

Overall, pre-service teacher attitudes towards ICT were strongly positive. Sex differences were only identified for one survey item in this category with male pre-service teachers believing more strongly than female pre-service teachers that ICT enhances the way they learn. As the analysis indicated, in general, male pre-service teachers were more confident in their overall level of ICT skill than female pre-service teachers. This finding may be a key component of the reason that males are more confident than females in ICT being able to enhance the way they learn.

For age, a statistically significant difference was only identified for one survey item. Pre-service teachers in the 22-23 years of age group believed more strongly than pre-service teachers in 18-19 years of age group that ICT has the potential to improve one's ability to teach. Possibly, pre-service teachers in the 22-23 years of age group having had more exposure to ICT could explain this difference between the age groups. However, interestingly there was no significant difference for this item for the 24 years and over group. This possibly suggests that expectations towards ICT may have tapered or plateaued in the older pre-service teachers.

For enrolment programme, a statistically significant difference was identified for one survey item. Pre-service teachers enrolled in the BEd (Dzongkha) believed more strongly than pre-service teachers enrolled in the BEd (Primary) that ICT can improve the academic performance of learners. It is an unlikely scenario that BEd (Dzongkha) compared to BEd (Primary) believed ICT could improve academic performance of

learners but the possible explanation could be that most of the BEd (Dzongkha) pre-service teachers who come to the college are equally exposed to ICT as other pre-service teachers.

For year of study in relation to attitudes towards ICT in education, a number of statistically significant differences were identified. While no general trends emerged, a few general observations can be made from the results. Third Year pre-service teachers tended to rate themselves higher for these significant survey items than their colleagues in lower and higher years of study. For example, Third Year pre-service teachers believed more strongly than Second Year pre-service teachers that ICT tools can make learning activities more efficient. A further example, Third Year pre-service teachers believed more strongly than Fourth Year pre-service teachers that ICT can improve the academic performance of learners. This could be further evidence of a tapering in expectations towards ICT for pre-service teachers in their final (Fourth) year of study. The only exception was for the survey item, ICT can make learning more efficient. In this instance, First Year pre-service teachers believed more strongly than Second Year pre-service teachers that this is the case. Possibly, First Year pre-service teachers, new to study, have more heightened expectations of the efficiency of ICT than their Second Year colleagues.

9.1.3 Pre-service teacher attitudes towards ICT enhancing GNH principles and values

The survey results indicated that pre-service teacher attitudes towards ICT enhancing GNH principles and values were strongly positive. There was however evidence that some GNH values and principles such as integrity, mindfulness and emotional well-being, were not as well understood by pre-service teachers as those values and principles such as creativity, enjoyment and relevance.

Sex differences were identified for two survey items, with male pre-service teachers rated these items higher than female pre-service teachers. These items were ICT has the potential to effectively internalise GNH values and using ICT tools can improve learner's emotional wellbeing. The possible reason for this could be that male pre-service teachers might have more access to ICT facilities at college because of the convenience in terms of time available compared to female pre-service teachers who are required to be in the hostel after 8 p.m.

The age of pre-service teachers was shown not to influence their attitudes to ICT enhancing GNH principles and values.

A number of statistically significant differences emerged based upon the enrolment programme of pre-service teachers. Pre-service teachers enrolled in the BEd (Dzongkha) more strongly endorsed the ICT enhancing GNH principles and values survey items than pre-service teachers enrolled in the BEd (Primary). These survey items had to do with ICT being used to enhance specific principles and values including efficiency, reflectiveness, mindfulness and emotional well-being plus ICT being used to become a better part of their lives. It is possible that pre-service teachers enrolled in the BEd (Dzongkha) had better understanding and appreciation of these GNH values and principles hence they were more confident in endorsing them.

Results according to year of study were varied and it was difficult to identify any discernible patterns in the results. First Year pre-service teachers were more positive towards ICT being used to enhance GNH values and principles such as creativity, mindfulness and ICT having the potential to internalise GNH values. As previously for attitudes towards ICT in general, First Year pre-service teachers may have more heightened expectations than their colleagues in later years of the potential for ICT being used to enhance GNH values and principles.

9.1.4 Pre-service teacher TPACK

In this section each of the four knowledges: Technological Knowledge, Technological Content Knowledge, Technological Pedagogical Knowledge, and Technological Pedagogical and Content Knowledge examined are reviewed in turn.

Technological Knowledge (TK)

Apart from keeping up with technology and playing with technology, pre-service teacher TK was considered to be relatively low. Results indicated that pre-service teachers were not confident in solving their own technical problems nor did they feel confident that they have the technical skills required to effectively use technology. There were very marked sex differences for TK, as for all of the TPACK elements. For all six items in the TK category there were statistically significant differences with male pre-service teachers rating themselves higher in all these items than female pre-service teachers.

A statistically significant difference according to age was identified for only one TK item - solving technical problems. Pre-service teachers in the 22-23 years of age group

were more positive in their ability to solve their own technical problems than pre-service teachers in 20-21 years. This may be due to the fact that many pre-service teachers come with limited ICT skills in First Year but then two years of experience at the college may have provided them with opportunities to learn more about solving technical problems.

For year of study, statistically significant differences were identified for four TK survey items. For these items, pre-service teachers enrolled in the BEd (Secondary) rated themselves higher in terms of their TK than their colleagues in other programmes. The discipline specialisation common to secondary teaching (especially, Mathematics, Computer Studies and Science teachers), may be the explanation for the greater level confidence in TK for pre-service teachers training for secondary education.

Technological Pedagogical Knowledge (TPK)

Results suggest that pre-service teachers were relatively more confident in their TPK than they were for TK. As for TK, male pre-service teachers rated themselves higher than female pre-service teachers for all TPK survey items. Similarly, marked differences were identified between the various age ranges for TPK. Interestingly a reasonably distinct pattern can be discerned. Pre-service teachers in the higher (22-33 years and 24 years and over) age ranges rated themselves higher in a range of TPK items than the younger (i.e., 18-19 years of age) pre-service teachers. Older pre-service teachers would be expected to be further into their pre-service teacher training, hence a higher level of confidence in their TPK would likely be expected.

For enrolment a statistically significant difference was only identified for the item on customizing the technology owned to different teaching activities. For this item, pre-service teachers enrolled in the BEd (Secondary) rated themselves higher than pre-service teachers enrolled in the BEd (Primary). As customizing technology for pedagogical purposes might require a reasonable level of technical expertise, the higher level of confidence in this area for pre-service teachers training for secondary education might be the major contributing factor.

There were some marked differences between pre-service teachers according to their year of study. The majority of Fourth, Third and Second Year pre-service teachers' responses to these TPK items were significantly higher than those of the First Year pre-service teachers. Furthermore, examination of the mean scores for the various years indicates an upward progression with the mean scores of these items generally

increasing with the year of study. This suggests that pre-service teacher TPK is increasing as they progress through their programmes of study.

Technological Content Knowledge (TCK)

Analysis of pre-service teacher TCK showed results that were roughly equivalent to those for their TPK. However, over one-third (34%) of pre-service teachers were uncertain about how to choose appropriate technologies to enhance the development of GNH values in lessons. So, while a greater level of confidence was expressed for TCK in general, pre-service teachers were less confident in using ICT in the enhancement of GNH values-related content in their lessons.

As for the previous two knowledges (TK and TPK), male pre-service teachers rated themselves higher in TCK than female pre-service teachers for all items in this category. Pre-service teachers typically had progressively higher means for these items with increasing age, suggesting pre-service teacher TCK increased with age.

Pre-service teacher year of study also typically increased, with pre-service teachers in the later years of study having better TCK than pre-service teachers in the earlier years of study. For programme of study, pre-service teachers enrolled in the BEd (Secondary) rated themselves higher than their colleagues enrolled in the BEd (Primary) for being able to choose technologies that enhance content for a lesson. As previously in TPK, this greater level of confidence may be due to pre-service teachers in secondary training being more adept with technology than their primary education counterparts.

Technological Pedagogical Content Knowledge (TPACK)

There appears to be contradictory results for the TPACK items with pre-service teachers rating themselves as relatively low for three of the four items in this category and high for the fourth item. This may have been due to them either misinterpreting this survey item or simply because they were more confident in the practical application of combining ICT, content and teaching approaches than they were in strategizing or providing leadership for such activities. As previously, there were sex differences apparent for all TPACK items with male pre-service teachers rating themselves higher than female-service teachers.

As for TPK and TCK, a pattern could be discerned with older pre-service teachers generally rating themselves as having better TPACK than younger pre-service teachers. Perhaps unsurprisingly, the same type of trend is also apparent in the year of

study results with pre-service teachers in the later years of study rating themselves higher than those in the early years of study.

There is good evidence to suggest that pre-service teacher TPACK increases across the years of study. For enrolment, only one statistically significant difference was identified; that being for providing leadership in helping others to coordinate the use of content, technologies and teaching approaches. As for the previous knowledges (TK, TPK and TCK), pre-service teachers enrolled in the BEd (Secondary) rated themselves higher than pre-service teachers enrolled in the BEd (Primary).

9.2 LECTURER PERCEPTIONS

This section provides discussion of the results from the analysis of the lecturer web-based survey data. It comprises four parts: lecturer perceptions of pre-service teacher attitudes towards GNH and GNH in education; lecturer perceptions of pre-service teacher attitudes towards ICT in education; lecturer perceptions of pre-service teacher attitudes towards ICT enhancing GNH principles and values; and lecturer TPACK.

9.2.1 Lecturer perceptions of pre-service teacher attitudes towards GNH and GNH in education

The results indicated that lecturers did not believe that pre-service teachers possessed adequate knowledge of GNH principles and values. Both male and female lecturers agreed in their perceptions of pre-service teacher attitudes towards GNH and GNH in education. Similarly, the results showed that the age and the teaching experience of lecturers did not influence their perceptions of pre-service teacher attitudes.

9.2.2 Lecturer perceptions of pre-service teacher attitudes towards ICT in education

Overall, lecturer perceptions of pre-service teacher attitudes towards ICT were positive with the majority of lecturers either agreeing or strongly agreeing for most of the items in this category. However, lecturers were unsure whether the pre-service teachers believe ICT to be an effective tool to create conducive learning environments for learners and whether the pre-service teachers believe ICT can improve the academic performance of learners. Both male and female lecturers held similar perceptions about the pre-service teacher attitudes towards ICT in education.

The age of lecturers had no influence on their perceptions of pre-service teacher attitudes towards ICT in education, apart from the lecturers in the 26 to 35 years of age group. This group were not confident that pre-service teachers believe ICT can make learning more efficient. The survey data collected cannot explain why this might be the case. However, this would be an area worthy of further exploration. The teaching experience of lecturers was also shown to have no influence on their perceptions of pre-service teacher attitudes towards ICT in education.

9.2.3 Lecturer perceptions of pre-service teacher attitudes towards ICT enhancing GNH principles and values

Lecturers were not as confident about pre-service teacher attitudes towards ICT enhancing GNH principles and values as they were about pre-service teacher attitudes towards ICT in education. Male lecturers were more confident than female lecturers in their perceptions about pre-service teacher attitudes towards ICT to enhancing GNH principles and values.

The age of lecturers did not influence their perceptions about pre-service teacher attitudes towards ICT enhancing GNH principles and values. Teaching experience of lecturers influenced their perceptions on ICT enhancing GNH principles and values for only one item, with lecturers being confident that the pre-service teachers believe ICT is an effective tool to learn about media literacy.

9.2.4 Lecturer TPACK

In this section each of the four knowledges: Technological Knowledge, Technological Content Knowledge, Technological Pedagogical Knowledge, and Technological Pedagogical and Content Knowledge examined are reviewed in turn.

Technological Knowledge (TK)

The lecturer survey results indicated that many of the lecturers did not know how to solve their own technical problem or did not know a lot about different technologies. While the majority of the lecturers are willing to use and experiment with technology, many were not confident in their ability to solve technical problems or learn to use new technology. Both male and female lecturers indicated similar TK. The age and teaching experience of lecturers did not influence their perceptions of their TK.

Technological Pedagogical Knowledge (TPK)

While many of the lecturers reported knowing how to use technology for pedagogical purposes, there were still some who expressed uncertainty about how to do so. Lecturers were most confident about being able to think critically on how to use technology for teaching activities and about their ability to select appropriate technologies to enhance classroom teaching. In contrast, lecturers were not confident about their ability to customise their own technology to different teaching activities. In general, males and females had similar levels of confidence in their TPK. However, in terms of lecturers being able to customise technology for different teaching activities, males were more confident than females. Lecturer age and teaching experience had no influence on their TPK.

Technological Content Knowledge (TCK)

While many of the lecturers indicated that they were able to choose technologies that enhance the development of GNH values, enhance lesson content, and enhance what they teach, others were uncertain about their Technological Content Knowledge. Male and female lecturers had similar Technological Content Knowledge. Lecturer age and the teaching experience had no influence on their Technological Content Knowledge.

Technological Pedagogical Content Knowledge (TPACK)

Overall, the results suggest that lecturers possessed some TPACK. However, for all the TPACK items there were more than one third of lecturers who showed uncertainty about their knowledge of TPACK. In particular, lecturers perceived themselves as having poor ability to provide leadership in helping others to coordinate content, ICT and teaching approaches. Both male and female lecturers possessed similar TPACK. Lecturer age and teaching experience had no influence on TPACK, apart from lecturers with 10 years or less of teaching experience who were more confident that they are able to use strategies that combine content, ICT, and teaching approaches than lecturers with 21 years or above teaching experience.

9.3 COMPARISON OF PRE-SERVICE TEACHER AND LECTURER PERCEPTIONS

In this section, the results of the pre-service teacher web-based survey and the lecturer web-based survey are compared and contrasted. It comprises four parts: attitudes

towards GNH and GNH in education; attitudes towards ICT in education; attitudes towards ICT enhancing GNH principles and values; and TPACK.

9.3.1 Attitudes towards GNH and GNH in education

Compared to the results of pre-service teachers, lecturers rated pre-service teachers lower than pre-service teachers rated themselves, for all three items related to attitudes towards GNH and GNH in education. So there is a level of disconnect between lecturer and pre-service perceptions of GNH and GNH in Education; while lecturers believe that pre-service teachers do not have adequate knowledge of GNH principles and values, pre-service teachers believe they do. The difference in perceptions between the two groups might be due to GNH values and principles not being clearly articulated or explicitly modelled to pre-service teachers. The implication is that if pre-service teachers are not fully aware of GNH values and principles these might not be reflected in their own teaching. Subsequently, the aim of a GNH infused curriculum might not be fully realised.

9.3.2 Pre-service teacher attitudes towards ICT in education

Compared to the results of pre-service teachers, lecturer perceptions of the pre-service teacher attitudes towards ICT in education were similar to the perceptions of the pre-service teachers for nine out of ten items. The only area where pre-service teachers rated themselves significantly higher than what lecturers rated them was in the belief that ICT is an effective tool to create conducive learning environment for learners. Perhaps, in this area pre-service teachers may have a better knowledge of how ICT can support their learning than their lecturers. Overall, the close alignment between lecturers and pre-service teachers in this area suggests lecturers have a good understanding of pre-service teacher views towards the use of ICT in education.

9.3.3 Attitudes towards ICT enhancing GNH principles and values

Compared to the results of pre-service teachers, lecturer perceptions of the pre-service teacher attitudes towards ICT enhancing GNH principles and values were similar to the perceptions the pre-service teachers had of themselves for more than half the items. Lecturers rated the pre-service teachers lower than the pre-service teachers rated themselves for five of the items related to the belief that ICT has potential to effectively internalise GNH values; enhancing GNH values such as integrity and mindfulness; and fostering GNH to better become part of their lives. Similar to attitudes towards

GNH and GNH in education discussed previously, the difference in perceptions between the two groups might be due to GNH values and principles not being clearly articulated or explicitly modelled to pre-service teachers; particularly when the use of ICT is involved. The difference might also be explained as due to a lack of knowledge of how ICT could be used to enhance GNH principles and values on the behalf of lecturers. In contrast, pre-service teachers may be more appreciative of the potential of the use of ICT enhance GNH principles and values than their lecturers.

9.3.4 TPACK

In this section each of the four knowledges: Technological Knowledge, Technological Content Knowledge, Technological Pedagogical Knowledge, and Technological Pedagogical and Content Knowledge examined are reviewed in turn.

Technological Knowledge (TK)

Compared to the results of pre-service teachers, lecturer perceptions of their own TK were similar to the pre-service teacher TK perceptions for all but one item. Pre-service teachers rated themselves significantly higher than lecturers in knowing a lot about different technologies.

Technological Pedagogical Knowledge (TPK)

Compared to the results of pre-service teachers, lecturer perceptions of their own TPK were similar to the perceptions pre-service teachers had of their TPK. Although this is a non-significant result, what might be considered important is the comparable levels of TPK of lecturers and pre-service teachers. It might reasonably be expected that lecturers would have higher levels of confidence in their TPK than pre-service teachers who are the students they are teaching. Interestingly, this appears not to be the case.

Technological Content Knowledge (TCK)

Compared to the results of pre-service teachers, lecturer perceptions of their own TCK were comparable to the perceptions pre-service teachers had of their TCK. Similar to TPK, this non-significant result might be important considering lecturers might reasonably be expected to be have higher levels of confidence in their TCK than pre-service teachers. Again, this appears not to be the case.

Technological Pedagogical Content Knowledge (TPACK)

Compared to the results of pre-service teachers, lecturers' perceptions of their own TPACK were similar to pre-service teacher perceptions of their own TPACK in three

out of the four items. However, lecturers rated themselves lower than pre-service teachers rated themselves for their skills to provide leadership in helping others to coordinate the use of content, ICT, and teaching approaches. Critically, it appears pre-service teachers feel more confident than their lecturers in providing leadership in the coordination of content, ICT and teaching approaches.

9.4 THE THEMATIC MODEL

Two broad themes emerged from the pre-service teacher focus group interviews and lecturer semi-structured interviews. The first, *Affordances of ICT* has two distinct sub-themes: *Current ICT Usage* and *Future Transformative Actions*. Each of these sub-themes is supported by five categories: *Access, Affective States, Communication, Environment,* and *User Characteristics*, common to both pre-service teachers and lecturers, with an additional *Planning* category unique to lecturers. The second theme *Challenges of ICT* comprised three categories: *Skills*, *Access*, and *College policy*, again, common to both pre-service teachers and lecturers. The following sections compare and contrast these two broad themes, with related sub-themes, and their constituent categories.

9.5 AFFORDANCES OF ICT: CURRENT ICT USAGE

The Current ICT Usage sub-theme of the Affordances of ICT theme captures the way ICT is currently being used at the college. Following is discussion of each of the categories within this theme: *Access, Affective states, Communication, Environment, Planning,* and *User characteristics.*

9.5.1 Access

Access is those factors that determine pre-service teacher and lecturer ability to utilise ICT. Two important ideas emerged from both pre-service teachers and lecturers: availability and equity.

Availability was mediated by the quality of the ICT services that the college provided to support teaching and learning. Pre-service teachers and lecturers had varying levels of access to different ICT such as computers, laptops, Smartphones, iPad and Internet. The majority of pre-service teachers and lecturers had access to smart phone technology. All pre-service teachers had access to the 150 laboratory computers and lecturers were provided with a dedicated laptop by the college. The computers in the laboratories were in high demand most of the time for classes, personal study and informal use. However, due to this over utilisation, infection by viruses, and computer

outages were frequent. This was exacerbated by the high ratio of pre-service teacher-to-technical support staff.

Pre-service teachers and lecturers had wireless access to the Internet via their smart phones and iPads. Both pre-service teachers and lecturers relied predominately on Internet resources for their learning and teaching. Access in most cases was restricted by poor bandwidth and the resulting slow Internet speed. In some classrooms, Wi-Fi connectivity was not available and pre-service teachers were not able to take advantage of Internet based resources.

Equity was associated mainly with unequal availability of different ICT and support, which may particularly disadvantage those who do not possess personal ICT or have a poor ICT background. First Year pre-service teachers who came to the college with poor ICT backgrounds, possibly due to lack of prior exposure to ICT, may have needed more time using ICT to up-skill. However, this extra time was not available. Lack of functioning computers in laboratories had implications especially for those pre-service teachers who did not own personal ICT devices. Social network tools and games were blocked Monday-Friday (9:00am-4:30pm) to prevent pre-service teachers from playing games and chatting online. Such restrictions were problematic for pre-service teachers who may have wished to use such tools for collaborative learning, particularly disadvantaging who did not own personal ICT.

9.5.2 Affective states

Affective states is the emotional and psychological aspects associated with the affordances of ICT. Four important ideas emerged from both pre-service teachers and lecturers: engaging, enjoyable, motivating, and overcoming anxiety.

Engaging both pre-service teachers and lecturers believed ICT was a meaningful engaging tool that has implications to quality teaching and learning. Both believed using ICT provided avenues for stimulating and challenging tasks for learners, providing enjoyable learning opportunities. The use of ICT has made it possible for both pre-service teachers and lecturers to share and collaborate with their peers, thus, engaging the pre-service teachers beyond the regular classrooms. Use of ICT has also shown to engage pre-service teachers informally with their family and friends. *Enjoyable* was associated with teaching and learning that was supported by creating engaging learning environment afforded by the use of ICT. For example, asynchronous

teaching and learning with ICT was shown to be particularly enjoyable for shy pre-service teachers.

Motivation was associated with meaningful engagement and enjoyable learning environment created by the use of ICT. Such a learning environment was shown to motivate pre-service teachers to learn because the interactive ICT made learning fun as well as improving retention of what is learnt. *Overcoming anxiety* afforded through the asynchronous teaching and learning afforded by the use of ICT. Bhutanese learners by nature are hesitant to ask questions of the teachers and this is true particularly of shy learners. ICT was shown to have helped those shy pre-service teachers who were not able to ask questions in class, to participate actively once they were online suggesting ICT helped them to overcome their inhibitions.

9.5.3 Communication

Communication is the methods that enable pre-service teachers and lecturers to interact and share. Pre-service teachers and lecturers communicated both formally, for academic activities, and informally, pertaining to interactions that took place with family and friends in order to stay connected. Some of the ICT tools utilised by pre-service teachers and lecturers include: the Internet, VLE, email, Facebook, blogs, Viber, WeChat, WhatsApp, Skype, and Pinterest. Four important ideas emerged from both pre-service teachers and lecturers: collaboration, connectedness, interaction, and sharing.

Collaboration was made possible by the use of different ICT tools. Using ICT was shown to produce an interactive learning platform where discussion and sharing of resources and ideas was made possible. *Connectedness* was associated with keeping in touch with family and friends. Being able to communicate free of cost using tools, such as Skype, and Facebook, was shown to have enabled pre-service teachers and lecturers to stay connected with their family and friends. *Interaction* was associated with being able to collaborate, connect, and share. Such social networking platforms enabled sharing of thoughts, ideas, and resources for class-related activities. *Sharing* involved exchanging of resources and ideas through the use of ICT. Different ICT tools have enabled both pre-service teachers and lecturers to exchange ideas and resources at the college. Moodle was specifically used for academic purposes while other social tools, such as Facebook and blogs, were used for informal communication, in particular sharing.

9.5.4 Environment

Environment is the variety of teaching and learning settings that are enabled by the affordances of ICT. Pre-service teachers and lecturers had both web-enabled and hardware-enabled environments. The web-enabled environment consisted of VLE, email, blogs, and Facebook. The hardware associated with the environment consisted of devices, such as iPads, smart phones, and cameras, used for both teaching and learning. Eight important ideas emerged from both pre-service teachers and lecturer: authentic, convenient, customisation (creativity), efficient, empowering, innovative, relevant, and transformative.

Authentic was associated with creating teaching and learning that resembled real-world activities. For example, the use of simulations made teaching of abstract mathematical concepts more realistic which otherwise would have been difficult to explain. *Convenient* was associated with making teaching and learning easier through the use of ICT. For example, ICT had made teaching much more convenient because of the use of the presentation software and LCD projectors. *Customisation (creativity)* was where pre-service teachers had opportunities to create tangible artefacts using ICT during teaching and learning, allowing them to demonstrate their creativity. Mash-up activities using MovieMaker was one example that emerged. *Efficient* was related to making better use of resources, especially time, during teaching and learning. For instance, using software to simulate certain chemical experiments that cannot be done in the college laboratory and in order to simulate mathematical situations for teaching about concepts, such as probability where tossing coins millions of times would be impossible.

Empowering was associated with pre-service teachers being able to have control over their learning. It was the use of the software such as MovieMaker and JavaScript that gave pre-service teachers a great deal of control over how to represent their learning. *Innovative* was where teaching and learning was created using ICT that encouraged creative and critical thinking activities. Both pre-service teachers and lecturers thought using ICT made pre-service teachers engage in creative tasks especially when ICT was used to create tangible artefacts. *Relevant* was associated with how teaching and learning was aligned with 21st century learner needs. Both pre-service teachers and lecturers thought that using ICT enabled them to engage in teaching and learning that was more realistic for learner needs in changing times. Collaborative and cooperative

learning opportunities afforded by ICT, such as the college Moodle and other social tools, were thought to be ways to achieve this.

Transformative was associated with possibilities that changed the way teaching and learning happened. Although the use of ICT by both pre-service teachers and lecturers was mostly basic, there were areas where teaching and learning had been enriched with ICT. Numerous examples were provided by both pre-service teachers and lecturers, where ICT had been used in constructivist ways. For example, social media tools, such as Facebook, were one of the commonly used tools for communication purposes in which pre-service teachers had shown to interact with friends from around the world and share ideas. College Moodle was another tool that was extensively utilised by pre-service teachers and lecturers for communications related to academic activities.

Three important ideas emerged just from lecturers: flexible, knowledge creation, and situated learning. *Flexible* was associated with the affordances of ICT that had changed the teaching and learning process, so that teaching and learning could happen anywhere and anytime. *Knowledge creation* was associated with teaching and learning where pre-service teachers had opportunities to use their imagination. An example of where ICT was utilised was the use of smart phones and cameras to create opportunities for pre-service teachers to represent their learning. *Situated learning* related to active participation of learners encouraging learning from real activities. Lecturers thought using ICT, such as discussion forums, provided pre-service teachers with opportunities to generate creative ideas.

9.5.5 Planning

Planning is the process in which ICT tools are utilised to plan, design, and implement instruction. Information about planning was only shared by the lecturers, and not by the pre-service teachers. Word processors, spreadsheets, multimedia/Presentation suites, and VLE were commonly used for lecturers' planning activities. Two important ideas emerged from the lecturers: learning environment, and pedagogy.

Learning environment related to a setting where different ICT was utilised to enrich teaching and learning. The planning tools comprised: word processors, spreadsheets, presentation software, the Internet, and VLE. Using these tools lecturers prepared and presented both lesson and term plans for their teaching. Since ICT allowed delivery of their instructions from anywhere and anytime, these tools had helped create learning

environments that were easier for both pre-service teachers' learning and lecturers' teaching.

Pedagogy was related to changing instructional style to include the use of ICT. The college had encouraged lecturers to utilise ICT to enhance their teaching approaches. For example, the college Moodle was used to enable pre-service teachers to collaborate and learn from each other, as well as share resources, resulting in the enhancement of lecturers' approaches to teaching at the college.

9.5.6 User characteristics

User characteristics is the style of learning exhibited by pre-service teachers and incorporated by lecturers to make ICT part of their teaching and learning. Two important ideas emerged from both pre-service teachers and lecturers: learning styles, and self-directed learning.

Learning styles was associated with the ways in which pre-service teachers learn. Pre-service teacher level of ICT use ranged from basic to Scripting language abilities. These skills had at least changed the way pre-service teachers learnt and lecturers taught at the college because use of ICT had provided a great deal of flexibility resulting in improved efficiency.

Self-directed learning was associated with pre-service teachers taking initiatives to learn on their own with ICT. The use of social tools such as blogs and Facebook were indicators of ICT being utilised by the pre-service teachers to learn on their own and at their own pace. Some pre-service teachers had portable devices, such as smart phones, to use, making learning more efficient as they were able to access resources from anywhere resulting in more flexible learning opportunities. Pre-service teachers' learning extended from the conventional classroom to beyond the bounds of the college campus, allowing them to have more control over what and how they leant.

Most lecturers' pedagogical practices were still didactic, even though the VLE and different Internet tools had the potential to engage pre-service teachers in higher order thinking in their learning activities, specifically around problem-based learning and critical thinking. A few savvy lecturers had used ICT to create self-directed learning opportunities for pre-service teachers, particularly using discussion forums on Moodle.

9.6 AFFORDANCES OF ICT: FUTURE TRANSFORMATIVE ACTIONS

Future Transformative Action is the potential to change the nature of things that can be done with ICT. Following is discussion of each of the categories within this theme: *Access, Affective states, Communication, Environment, Planning,* and *User characteristics.*

9.6.1 Access

Access is different types of ICT infrastructure that pre-service teachers and lecturers have the potential to utilise in the future. Access in the future may be influenced by the quality of ICT services available to support teaching and learning. Two important ideas emerged from both pre-service teachers and lecturers: availability, and restrictions.

Availability to ICT and ICT infrastructure was believed to be a key factor that could better enable pre-service teachers and lecturers to leverage the affordances of ICT for teaching and learning. Pre-service teachers believed adequate availability of different ICT was important for their learning because it is through computer devices that they get can access a variety of learning resources. Pre-service teachers believed an adequate pre-service teacher-computer ratio could make a great deal of difference in their ability to use ICT for learning. Both pre-service teachers and lecturers believed greater Internet speed was likely to improve pre-service teachers' ability to use ICT. In addition, stable ICT infrastructure, such as Wi-Fi connectivity, could help provide better access to online resources thereby allowing learning to be more flexible. To leverage the maximum potentials of ICT, pre-service teachers believed technical support is of paramount importance because if pre-service teachers do not receive adequate support, this could hinder their ability to use the available ICT.

Restrictions were associated with rules that the college had in relation to the use of certain ICT infrastructure. Due to the misuse of certain tools, such as Facebook to chat and game, the college had rules that blocked social media during class hours which prevented serious users from engaging in learning-related use. Wi-Fi facilities at the hostels were blocked during the day. These rules were perceived by both pre-service teachers and lecturers to be a potential problem in the future because Internet access was crucial to many facets of learning. Lecturers were not impacted by these rules because they did not use restricted tools or hostel Wi-Fi facilities.

9.6.2 Affective states

Affective states is the condition where ICT has the potential to create emotional and psychological impact on teaching and learning. Four important ideas emerged from both pre-service teachers and lecturers: engaging, enjoyable, motivating, and overcoming anxiety.

Engaging was associated with involving pre-service teachers with the use of ICT. Pre-service teachers and lecturers thought that using ICT such as blogs and discussion forums, have the potential to actively and meaningfully involve pre-service teachers in a range of collaborative learning opportunities. Such affordances of ICT were perceived as likely to benefit the pre-service teachers in accessing opportunities for more flexible learning where learning goes beyond the classroom or even beyond the college.

Enjoyable has relevance to positive emotional connection with learning. The ambient learning environment created by the use of ICT has potential to make learning fun. Use of social media tools, for instance, is likely to facilitate learning that allows interaction and collaboration with others to solve instructional problems, creating a learning context that enables co-creation of knowledge.

Motivating was related to the engaging and enjoyable learning environments that have the potential to make pre-service teachers want to learn more. Discussion forums, blogs, Facebook, and Pinterest were some of the examples of social media tools that were thought to be useful for creating teaching and learning with real-world relevance. They thought that such learning opportunities with ICT would create avenues where learners would be interested to learn more.

Overcoming anxiety has to do with teaching and learning where learner inhibitions were removed. Both pre-service teachers and lecturers acknowledged that ICT could be used to overcome many cultural barriers, such as Bhutanese learners refraining from asking teachers questions. There was the possibility that the use of ICT, especially social media tools, has immense potential to make pre-service teachers, especially the shy ones, participate more actively in learning.

9.6.3 Communication

Communication is the method that allowed pre-service teachers and lecturers to interact and share. The affordances of ICT pre-service teachers and lecturers perceived

were that it can enable both formal and informal communications. The ICT tools that they utilised included: the college VLE, blogs, email, Facebook, Pinterest, Viber, WeChat, and Skype. Three important ideas emerged from both pre-service teachers and lecturers: collaboration, connectedness, and sharing.

Collaboration was when teaching and learning took place through interaction and co-learning with others. Both pre-service teachers and lecturers agreed that teaching and learning could be more interactive when learning included interaction not only with one's peers and teachers, but also with others outside the college, such as experts from overseas. This they thought could be possible with social media tools. *Connectedness* was associated with being in contact with one's family and friends on a frequent basis. The affordances of ICT they thought would make both formal, to enhance teaching and learning, and informal, contact with loved ones on a regular basis, associations with people possible. *Sharing* was relevant to giving and receiving help in terms of resources and ideas for teaching and learning. Pre-service teachers and lecturers thought that the sharing of resources and ideas with others would be effective assisting in solving problems collaboratively using ICT.

9.6.4 Environment

Environment is the wide variety of teaching and learning settings that are enabled by the affordances of ICT, bringing about potential transformational changes to the teaching and learning process. Computers, laptops, iPads, smart phones, and web-based tools were common tools with the potential to create transformative teaching and learning environments. Seven important ideas emerged from both pre-service teachers and lecturers: authentic, convenient, customisation (creativity), empowering, innovative, relevant, and transformative. Three important ideas emerged just from lecturers: flexible, knowledge creation, and situated learning.

Authentic was associated with designing teaching and learning opportunities that resembled real-world settings. Pre-service teachers and lecturers believed that the use of ICT could transform teaching and learning from lecturer-driven to more learner-driven. *Convenient* was associate with ICT making teaching and learning easier. Pre-service teachers and lecturers thought using ICT had the potential to make teaching and learning much easier because teaching and learning could take place from anywhere and at anytime. *Customisation (creativity)* was related to being able to create something new with the help of ICT. Pre-service teachers and lecturers believed using

ICT would engage them in more creative tasks giving opportunities for inventive works.

Empowering was associated with pre-service teachers having control over their learning. Both pre-service teachers and lecturers acknowledged that using ICT could potentially create learning environments that provided learners with much more control over their learning because in an ICT-enabled learning environment learners can choose to learn at their own pace and from whomever they choose. *Innovative* related to using ICT for teaching and learning that encourages higher-order thinking in ways not previously utilised. Pre-service teachers and lecturers thought that using ICT as part of creative activities would allow pre-service teachers to be involved in creating artefacts relevant to their learning. *Relevant* related to teaching and learning in the future that was situated in familiar context. Pre-service teachers and lecturers were of the opinion that what the pre-service teachers learn about teaching and learning with ICT should be appropriate for their future teaching. In particular, collaboration and interaction afforded by ICT need to be included in teaching and learning.

Transformative was associated with enhancing teaching and learning approaches to create radical changes to practice. The learning environment enabled by ICT was likely to enrich pedagogical practices by transforming teaching and learning from didactic to a more constructivist approach where collaboration, communication, creativity, and critical thinking could be encouraged. In such ICT-enabled engaging teaching and learning environments, they believed that their pedagogical approaches would be immensely transformed so that pre-service teachers could learn and lecturers could teach in more flexible ways, with learning not confined to the classroom.

Three ideas specifically emerged from lecturers only: flexible, knowledge creation, and situated learning. *Flexible* was associated with the affordances of ICT that could potentially change the teaching and learning as teaching and learning would occur anywhere and anytime. *Knowledge creation* was associated with teaching and learning that would potentially encourage pre-service teachers to use their imagination. Using ICT could enable pre-service teachers to engage in creative tasks and produce things that have novelty. *Situated learning* related to the active participation of learners encouraging learning through real activities. Lecturers thought using ICT, such as blogs, could provide pre-service teachers with opportunities to generate creative ideas.

9.6.5 Planning

Planning is how utilisation of ICT tools has the potential to bring about changes to teaching and learning where the affordances of ICT could potentially aid lecturers in planning, designing, and implementation. Information about planning was specific to lecturers only. Two important ideas emerged from lecturers: learning environment and pedagogy.

Learning environment was associated with creating efficient teaching and learning settings using ICT. Lecturers believed that by using ICT they could create learning environments that were conducive to pre-service teachers' learning. Lecturers believed using ICT has the potential to design and implement instructions that are suitable for pre-service teachers with diverse learning styles and preferences.

Pedagogy was associated with creating environments where teaching approaches could be changed by using ICT. Lecturers thought that by using ICT they could approach teaching in ways that better met the needs of 21st century teaching and learning. For example, using blogs, lecturers thought they could create environments for those pre-service teachers who need time and space to think and to learn, fulfilling the diverse learning styles of learners.

9.6.6 User characteristics

User characteristics is the style of learning the pre-service teachers might exhibit in future or the lecturers might design their teaching to encourage. Two important ideas emerged from both pre-service teachers and lecturers: learning styles, and self-directed learning.

Learning styles was associated with the different ways learners learn. Both pre-service teachers and lecturers thought that using ICT could potentially benefit learners with diverse learning styles because activities could be designed which allow pre-service teachers to learn in ways that best suited their learning style. For instance, visual learners could potentially benefit from using multimedia tools.

Self-directed learning was associated with pre-service teachers taking more responsibilities for their own learning. Pre-service teachers and lecturers believed that using ICT could provide a way for pre-service teachers to learn at their own pace, with opportunities to reflect and take responsibility for their own learning. Use of social

media tools, such as Moodle, were perceived as potentially useful for designing such learning opportunities.

9.7 CHALLENGES OF ICT

Challenges of ICT are those elements that act as obstacles to using ICT to transform teaching and learning. The following is a discussion of each of the three categories: *Skills*, *Access*, and *College policy*.

9.7.1 Skills

Skills are those abilities required to use ICT in teaching and learning. One important idea emerged from both pre-service teachers and lecturers: ICT. One important idea emerged just from lecturers: pedagogy.

ICT was related to the technical skills required to use ICT by pre-service teachers and lecturers. The challenge that pre-service teachers and lecturers faced was their lack of ICT skills. Both thought that lack of ICT skills was a problem to them because they were not able to utilise ICT to enhance their pedagogy, which may be the reason why they use so little ICT.

Pedagogy was related to the skills necessary to improve approaches to teaching and learning using ICT. Lack of pedagogical skills in using ICT was perceived to be an obstacle for lecturers. Most of the lecturers thought their lack of pedagogical skills were stopping them from using ICT to transform teaching from a transmission approach to a more constructivist approach. This lack of relevant pedagogical skills may be the reason why presentation software, such as PowerPoint, was being used to deliver lessons in traditional ways very much like when a chalkboard was used.

9.7.2 Access

Access is associated with the opportunities pre-service teachers and lecturers had to use ICT for teaching and learning. Three important ideas emerged from both pre-service teachers and lecturers: Internet bandwidth, computers, and Wi-Fi facilities.

Internet bandwidth was associated with the speed of the Internet connectivity at the college. Lack of good Internet speed was thought to be a problem for both pre-service teachers and lecturers, hindering their ability to utilise ICT for teaching and learning.

Computers was that ICT the college provided to pre-service teachers and lecturers. Access was problematic due to inadequate pre-service teacher-computer ratio. The

computers in the pre-service teacher computer laboratories were in high demand and many of those computers failed frequently, resulting in difficulties in making full use of the computers. The problem it was thought was also due to pre-service teachers occupying those facilities to chat and play games on social networking sites. Lack of adequate technical support, particularly when computers in the laboratories break down, had caused problems for pre-service teachers, as they were not able to use the facilities.

Wi-Fi facilities was the infrastructure set up at the college to provide Internet services. These services were blocked at certain times of the day making them inaccessible to pre-service teachers. Pre-service teachers thought this was preventing them from using ICT as they were heavily dependent on the Internet for their teaching and learning resources. Additionally, inefficient Wi-Fi also contributed to pre-service teachers not being able to utilise college facilities. For instance, in some of the classrooms a Wi-Fi signal was available but not strong enough to be useful thus causing problems for both pre-service teachers and lecturers.

9.7.3 College policy

College policy is the rules and regulations governing ICT use at the college that had implications for teaching and learning. The college rules had certain restrictions when it came to using ICT. These rules did not have a direct bearing on lecturers for their teaching but did have some indirect impact. Two important ideas emerged from both pre-service teachers and lecturers: restrictions on hardware usage, and restrictions on Internet usage.

Restrictions on hardware usage was related to the degree of control on the use of ICT hardware. Pre-service teachers were not allowed to use smart phones in the classroom. Pre-service teachers thought smart phones were useful tools that enabled them to access and explore a variety of learning resources and so they should be allowed to use them. Although lecturers thought that the use of mobile hardware, such as smart phones, was useful for teaching and learning, they believed that such hardware caused disturbances in the classroom and hence should not be used during class time.

Restrictions on Internet usage related to inaccessibility to Wi-Fi facilities in the pre-service teacher hostel area and inaccessibility of certain social media tools. Wi-Fi facilities were blocked during the day in and around the pre-service teachers' hostel to discourage pre-service teachers from staying in the hostel. However, pre-service

teachers thought this was a problem because being able to use the Wi-Fi would enable them to learn anywhere and at anytime. Another problem faced by pre-service teachers was related to their inability to access social networking tools. Such sites were blocked by the college administration, as the tools were often misused with the pre-service teachers chatting and playing games, rather than using them for collaborative learning. Lecturers thought restricting pre-service teachers from using certain web applications had an indirect impact on their teaching. For example, lecturers believed social media tools, such Facebook, would be very useful for teaching and learning but they were unable to include their use in everyday teaching and learning activities because the social media tools were blocked by the college administration during the day.

9.8 INTEGRATION OF THEMES

The themes and sub-themes are pictorially represented (Figure 9.1) to highlight the dynamics of the interplay between the *Current ICT Usage*, the suggested *Future Transformative Actions*, and the *Challenges of ICT*. From the thematic analysis it emerged that for the affordances of ICT to be realised through future transformative actions the challenges of ICT have to be overcome. Surprisingly, the thematic analysis of both pre-service teacher and lecturer interview results indicated no evidence of GNH principles and values being intentionally taught or even stressed. Even after prompting during the interviews no themes on GNH principles or values emerged other than just the indication of GNH principles and values being supported but not necessarily linking to the lecturer pedagogical practices. This is an indication that the college may need to have a greater focus on stressing the importance of incorporating GNH principles and values especially in the classroom. This is particularly because GNH is the core of the Bhutanese education system. Moreover, if pre-service teachers are not adequately exposed to GNH principles and values while at the college through the lecturers' teaching, the transference of how to inculcate the GNH principles and values in schools might not happen. This also suggests that lecturers are not modelling how to inculcate GNH values and principles in their lessons, which they should as mandated by the education system.

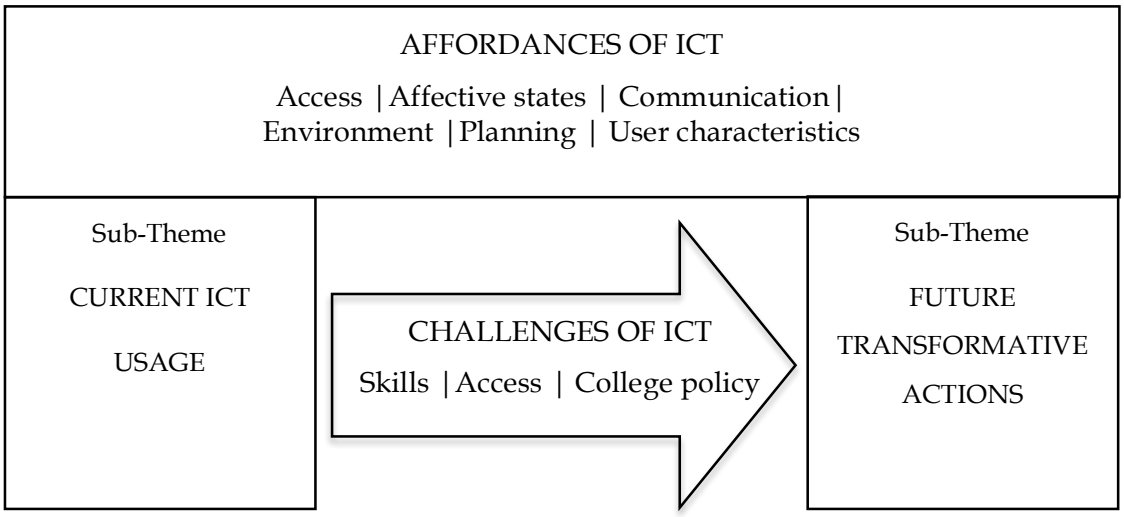


Figure 9.1. Relationship of the themes

9.9 VIEWING THE QUALITATIVE AND QUANTITATIVE DATA THROUGH THE SAMR LENS

This section examines the results of the thematic analysis and the quantitative analysis through a SAMR model lens to assist in informing the study concerning the level of ICT integration at Paro College of Education. While much of the following discussion originates from the thematic analysis of qualitative data, relevant results from the quantitative data are brought in to support the ideas being presented.

9.9.1 SAMR model

As described in Chapter Two, Substitution, Augmentation, Modification, and Redefinition (SAMR) (see Figure 2.2) is a model that provides a taxonomy of different levels of technological tool usage for educational purposes. There are two domains in the model: *Enhancement* and *Transformation*. The *Enhancement* domain is when the level of usage is either *substitution* of the old technology or *augmentation* of a slight change in some functionality in the manner in which the tools are utilised. *Transformation* domain is when the level of usage is either *modification* where technology allows for significant task redesign or *redefinition* where technology allows for creation of new tasks previously not possible.

Analysis of pre-service teacher and lecturer surveys were not by specific ICT tool utilised, instead should be viewed from the perspectives of analysis of ICT tools in general. Analysis of the pre-service teacher focus group interviews and the lecturer

semi-structured interviews, backed up by the survey results, viewed through the lens of SAMR indicated that both groups were using ICT mainly in the *Enhancement* domain - encompassing the *substitution* and *augmentation* levels. The ICT tools used at the college were functionally categorised into five groups to aid analysis. These groups and the SAMR levels of their use, as indicated in the data analysis, are presented in Table 9.1 followed by a discussion of the various tool groups. The increasing depth of shading in Table 9.1 indicates the increasing level of usage of ICT, from the lightest shading for the substitution level to the darkest shading for the redefinition level. Note that there was no usage at the *redefinition* level and hence the table only contains three different depths of shading.

Table 9.1. ICT tool use categorised according to SAMR model

Tools group	**Participants**	**Enhancement**		**Transformation**	
		Substitution	*Augmentation*	*Modification*	*Redefinition*
Productivity Tools	Pre-service teachers				
	Lecturers				
Social media tools	Pre-service teachers				
	Lecturers				
Web based resources	Pre-service teachers				
	Lecturers				
Virtual Learning Environment	Pre-service teachers				
	Lecturers				
Hardware	Pre-service teachers				
	Lecturers				
Video tools	Pre-service teachers				
	Lecturers				

9.9.2 Productivity tools

Examples of productivity tools used are: word processor - MS Word; spreadsheet - MS Excel; Presentation - PowerPoint; Note Taking - Evernote; and Collaboration software - Google Docs.

Both pre-service teacher and lecturer use of productivity tools fell predominantly under the *Enhancement* domain of the SAMR model. Pre-service teachers predominately used, word processors for assignment preparation; spreadsheets for the collection and presentation of data; presentation tools for individual and group project presentation; note taking for lectures and workshops; and collaborative for document sharing and collaboration.

Lecturers predominately used word processors for administrative work including lesson and assignment preparation; spreadsheets for administrative tasks including result processing, and the collection, analysis and presentation of data; presentation tools for lesson presentation; and collaboration tool were used by a small number of lecturers as part of setting pre-service teacher tasks. Interestingly, note taking tools were not mentioned.

It was noted that the use of *Google Docs* by pre-service teachers as a collaborative tool often situated its use at the *modification* level of the SAMR model. However, the small amount of use of productivity tools at this level did not warrant shading of the *modification* block in Table 9.1.

9.9.3 Social media tools

Examples of social media tools used are: Viber, WeChat, WhatsApp, Skype Facebook and Blogs.

Pre-service teachers used free applications and services mainly for informal contact with friends and family rather than for formal learning purposes. As a means of circumventing college restrictions of social media, many pre-service teachers often used these tools on their own mobile devices. Lecturers indicated that they did not use these tools purposely to support their teaching. Pre-service teachers formally used the social media tools to collaborate with peers and also to communicate with a broader audience beyond the college. The use of both Facebook and blogs enabled pre-service teachers to create artefacts, have discussions, receive feedback, share ideas and resources, and co-create knowledge. Therefore, these interactions aligned with *modification* level of the SAMR model.

Lecturers, on the other hand, seldom utilised these tools for teaching and learning, except on the rare occasion for sharing information and resources to a broader community. Thus, lecturers were operating mainly at the *substitution* level.

9.9.4 Web-based resources

Examples of web-based resources accessed are: online news, multimedia resources, journals, report, government documents, and Wikipedia.

Web-based resources were utilised both by pre-service teachers and lecturers informally to access current affairs information, news, games and multimedia

resources. Formally, pre-service teachers accessed journals, reports, government documents and factual websites to support their learning.

Lecturers mainly depended on the Internet to provide teaching and learning resources. This access was predominately at the *substitution* level.

9.9.5 Virtual Learning Environment

The only virtual learning environment used was the college platform: Moodle.

The college Moodle was the official platform used by pre-service teachers, primarily for learning purposes. Pre-service teachers used this platform to receive official announcements from administration; submit their assignments and projects; and view lesson plans and term plans uploaded by the lecturers. This access was predominately at the *substitution* level. Moodle also offered a platform for pre-service teachers to discuss, share and collaborate with peers and lecturers. When this occurred, the use of the VLE shifted from the *substitution* to the *augmentation* level.

Lecturers use the college Moodle to make announcements; upload teaching and learning materials including term plan and lessons; and share resources with pre-service teachers and fellow lecturers. This access is predominately at the *substitution* level and was deeply rooted in a didactic approach to teaching.

9.9.6 Hardware

Examples of hardware used are: Computers, Laptops, iPads, Cameras, LCD projectors and Smart phones.

Pre-service teachers used hardware for writing assessment related tasks including writing assignments because it is easier to produce assessment materials using hardware, such as computers, than using paper pens. Pre-service teachers thought that using hardware, such as cameras and LCD projectors, for representing their learning was convenient. These examples suggest that the nature of technology used by the pre-service teachers was at the *augmentation* level where there is no significant task redesign. However, on a few occasions the pre-service teachers had used hardware such as cameras at the *modification* level.

Hardware commonly used by the lecturers included laptops, smartphones, and LCD projectors and was used to access online resources, and plan and present their lessons. They thought using LCD projector was much more convenient than using the chalkboard indicating that the lecturers were using ICT at the *substitution* level.

9.9.7 Video tools

Examples of video tools used are: Flash, MovieMaker; and YouTube for sharing.

Pre-service teachers identified a few movie editing tools they utilised for their learning. For example, Moviemaker and Macromedia Flash were used to prepare multimedia elements and do mash-ups activities, indicating that the pre-service teachers were using video tools at the *transformation* level. However, such occurrences were rare and restricted to those pre-service teachers majoring in ICT. A popular video tool used was the video-sharing tool YouTube, through which pre-service teachers watched movies with educational relevance.

Lecturers hardly used video making tools in their own teaching, perhaps because they set scenarios for pre-service teachers to use these tools. However, the video sharing tool YouTube was commonly used by the lecturers to support their teaching. Such use was at the *enhancement* level.

9.9.8 SAMR Overall Context

Analysis through the SAMR lens shows that the highest level of usage of ICT attained at the college was *modification*. Overall, as shown in Table 9.1 the majority of ICT use at the college was in the *Enhancement* rather than *Transformation* domain. Critically, it appears that in general, the pre-service teachers were main drivers of innovation at the college when it came to using ICT.

The aim of Educating for Gross National Happiness is to bring about transformational changes to the existing curriculum without adding anything new (Ministry of Education, 2011). However, the evidence presented here suggests that the desired level of transformation is not being achieved nor is it likely to by the way ICT is currently being utilised at the college.

9.10 VIEWING THE QUANTITATIVE AND QUALITATIVE DATA THROUGH THE TPACK LENS

This section examines results of the quantitative analysis and the thematic analysis through the TPACK framework to assist in informing the study concerning the level of ICT integration at Paro College of Education. While much of the following discussion originates from the analysis of the quantitative data, relevant results from the thematic analysis of the qualitative data are brought in to support the ideas.

9.10.1 TPACK Framework

As described in Chapter Two, the TPACK framework (see Figure 2.1) has seven inter-related types of knowledge. To review, for the purposes of this study only those TPACK dimensions associated with technology were specifically examined: Technological Knowledge (TK), Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK) and Technological Pedagogical Content Knowledge (TPCK). The following examines each of these four knowledges.

9.10.2 Technological Knowledge (TK)

Analysis of the pre-service teacher survey identified that although the pre-service teachers were positively inclined to learning about new technology they lacked TK. This was corroborated by the pre-service teacher focus groups interviews, where for example, many pre-service teachers discussed how they were interested in learning how to use tools such as Moviemaker in their learning but were constrained by their lack of skill to use such software. Much of their use of ICT was limited to using social media tools to post and comment on friends' social media pages. Moodle was mainly used to upload or retrieve materials instead of been used for highly interactive teaching and learning activities using discussion forums. Lecturers indicated that they too lacked TK. For example, common ICT used by the lecturers was limited to PowerPoint presentations with LCD projectors merely replacing the chalkboard. Further evidence of lecturer lack of TK was the manner in which the college Moodle was being used, simply to upload resources and make official announcements as opposed to it being used as an effective teaching and learning tool supporting interaction and collaboration.

9.10.3 Technological Pedagogical Knowledge (TPK)

The pre-service teacher survey indicated that pre-service teachers were confident in their TPK. Pre-service teachers mentioned in the focus group interviews numerous examples where ICT was used in their learning. However, this should be viewed with caution because the general pedagogy pre-service teacher learn through two pedagogical modules, such as teaching skills and teaching strategies, may have influenced their responses.

Although the lecturer survey results indicated that lecturers believed they possessed TPK, thematic analysis of the lecturer interviews suggested otherwise, indicating that lecturers lacked the TPK necessary for effective use of ICT.

9.10.4 Technological Content Knowledge (TCK)

Overall, the pre-service teachers possessed TCK, although this varied according to the year of study, with the level of TCK increasing progressively from First Year through to Fourth Year. However, one third of the pre-service teachers were unsure about their TCK. One possible explanation for this uncertainty could be because the First Year pre-service teachers had just joined the college a few weeks prior to the data collection for this study thus impacting their knowledge of pedagogical ideas. Thematic analysis of the focus group interviews indicated that pre-service teachers, in fact, lacked TCK because when asked to explain TCK in more detail they indicated that they did not understand how technological knowledge and content knowledge were related.

Although lecturer survey results indicated that the lecturers possessed TCK, thematic analysis of lecturer interviews indicated otherwise. Lecturers reported not knowing how to use a particular ICT for the delivery of specific content.

9.10.5 Technological Pedagogical Content Knowledge (TPACK)

Both pre-service teachers and lecturers indicated in their survey results they possessed TPACK. However, thematic analysis highlighted their lack of TPACK. Many of the examples provided by both pre-service teachers and lecturers demonstrated that they did not possess TPACK. The majority of examples of ICT being used by pre-service teachers were limited to uploading or downloading materials from the Internet. For instance, most of the time the college VLE, Moodle, was being used to access official announcements, retrieve lecturer notes/materials, or to upload assessments, instead of Moodle being used to engage pre-service teachers in intellectual activities requiring 21st Century skills. Most examples of ICT being used by lecturers was restricted to using Moodle to make announcements and upload materials, and replacing the use of chalkboards using PowerPoint presentations over the LCD projectors. Lessons were still lecturer-driven even with the use of ICT, further indicating a lack of TPACK.

9.11 ADDRESSING THE RESEARCH QUESTIONS

Having discussed the pre-service teacher and lecturer surveys, the pre-service teacher semi-structured focus group interviews, and the lecturer semi-structured interviews, the research questions for the study are now addressed.

9.11.1 What are pre-service teacher and lecturer attitudes towards GNH?

The web-based survey indicated positive attitudes towards GNH principles from pre-service teachers and lecturers. Both pre-service teachers and lecturers are highly supportive of the idea that GNH principles and values should be infused into the pre-service teacher curriculum. However, despite the study's focus being on GNH and the implied bias that this focus might be expected to cause, no GNH related themes or even categories emerged from the interviews of both pre-service teachers and lecturers.

From a pre-service teacher perspective, their knowledge of GNH principles and values grew as they progressed through college (First Year to Fourth Year). The marked difference was that compared to pre-service teachers from other disciplines, Dzongkha pre-service teachers had a better knowledge and confidence of GNH principles and values. This could be a reflection of greater empathy to cultural values because Dzongkha pre-service teachers come from the language and cultural associated institutes where Bhutanese culture is stressed heavily. This indicates that pre-service teachers from other disciplines may require more assistance in developing their understanding of GNH principles and values while at the college.

Despite positive attitudes towards GNH, the study's findings suggest GNH principles and values are not being intentionally taught or stressed by the lecturers. This is in contrast to the government's aspirations of making GNH principles and values part of students' everyday school life (Ministry of Education, 2011). This misalignment of what is intended and what is enacted is problematic, especially if the intention is to make GNH principles and values cascade through to school system starting with the graduates of the colleges of education as they go out and become teachers themselves. The implication for policy is that GNH principles and values should be intentionally taught. This could be achieved through the alignment of curriculum with what Educating for GNH espouses. Critically, unless pre-service teachers are introduced to the strategies for teaching GNH principles and values through the different subject disciplines, a comprehensive understanding of GNH may not materialize.

The lack of GNH related themes or even categories emerging from the focus groups and interviews of pre-service teacher and lecturers may be due to GNH principles and values being so embedded in the culture and in peoples' minds that there is the feeling that there is no real need to be explicit about them. It may have been the view of lecturers that GNH principles and values are automatically being inculcated in their day-to-day although not openly stressed. Therefore, GNH principles and values are not even being considered which has implications for pre-service teachers if they are to carry forward the ideas to the wider school system when they graduate.

To conclude, both pre-service teachers and lecturers perceive GNH principles and values as important and a necessary part of the pre-service teacher curriculum and this is an indication of positive attitudes towards GNH principles and values. However, on the part of the lecturers, the problem is that they are not being explicit when teaching or talking about GNH. This has implications with respect to *Educating for GNH* particularly if GNH principles and values are not being explicitly modelled by lecturers to pre-service teachers in order that these GNH principles and values may be carried into the next generation of classrooms.

9.11.2 What are pre-service teacher and lecturer attitudes towards ICT use?

Pre-service teachers coming to the college for the first time typically fell into two broad groups. The first group were pre-service teachers who were reasonably confident and competent in basic ICT use. The second group, came with little or no ICT skills but with high expectations of how ICT might be used to enhance teaching and learning. However, after one or two years at the college, the gap in ICT use and knowledge between these two groups closes in relation to educational use of ICT.

The emergence of the theme *Affordances of ICT* is evidence that pre-service teachers and lecturers view ICT positively. Further evidence was the emergence of the sub-theme *Future Transformative Action* which indicates that ICT is considered to have a positive future at the college, continuing to influence teaching and learning.

Analysis of the pre-service teacher survey and focus group interview responses revealed that pre-service teachers believed that ICT is of immense benefit to them. Pre-service teachers believe using ICT creates learning environments that are efficient and effective. ICT helps create learning that is relevant, imaginative, reflective, creative, collaborative, enjoyable, engaging, motivational, and empowering, which are interestingly, attributes of constructivist learning. These also align with a number of

GNH principles and values giving further support to the idea that ICT can be used to enhance GNH principles and values. Pre-service teachers also believe that ICT has the potential to enhance their academic performances.

Furthermore, thematic analysis of the pre-service teacher focus group interview responses suggest that pre-service teachers are willing to learn additional ICT skills, for example, using digital cameras, Flash, and JavaScript. This further indicates pre-service teacher positive attitudes towards ICT. It is worth noting that - notwithstanding pre-service teacher positive attitudes towards ICT - their use of ICT remains predominantly in the *enhancement* domain of the SAMR model.

Lecturers predominately had only basic ICT technical skills as evidenced by the survey and lecturer interview analysis. There are however, a few ICT savvy lecturers with a relatively high level of ICT skills linked to their technology-based disciplines.

Similarly, lecturers have positive attitudes towards ICT. Like the pre-service teachers, lecturers believe that ICT can enhance teaching and learning. Importantly, despite acknowledging a lack of ICT skills, lecturers remain willing to embrace ICT in their teaching. Lecturers expressed a desire to improve their ICT skills. Similar to the pre-service teachers, lecturer use of ICT was predominately in the *enhancement* domain.

9.11.3 What are the enablers of the use of ICT to enhance GNH in education in pre-service teacher education?

There were three enablers to using ICT to enhance GNH in education. First, the emergence of the theme *Affordances of ICT* is evidence that both pre-service teachers and lecturers view ICT positively, which is a powerful enabler. It can be argued that unless pre-service teachers and lecturers have a positive inclination towards using ICT, it is unlikely that they will use ICT to enhance GNH principles and values. The pre-service teachers' and lecturers' positive inclination towards ICT make it possible to use ICT to create learning environments that are ambient, relevant, realistic, and promote creativity, critical thinking, and learner-centredness. These are objectives for which *Educating for GNH* aspires to achieve.

Second, a powerful enabler is the emergence of the sub-theme *Future Transformative Actions*. Thematic analysis of both pre-service teacher focus group interviews and lecturer semi-structured interviews indicate that pre-service teachers and lecturers are aware of both how the current affordances of ICT are being met and what future transformative actions are required. In this sense, both pre-service teachers and

lecturers possess a 'road map' of where they currently are in terms of the use of ICT to enhance GNH principles and values and where they intend to go in the future. This is a very powerful enabler.

Third, there are a small number of savvy pre-service teachers and lecturers who have both a positive attitude towards ICT and a good level of ICT skill. These college members can play a crucial leadership role in rendering support to the wider population. Such leadership roles undertaken by ICT savvy pre-service teachers and lecturers could also aid in the sustainable use of human resources.

What are the inhibitors of the use of ICT to enhance GNH in education in pre-service teacher education?

The emergence of the theme *Challenges of ICT,* indicates that there are inhibitors preventing the use of ICT to enhance GNH principles and values at the research site. The analysis identified three possible inhibitors to the use of ICT to enhance GNH principles and values.

First, thematic analysis of both pre-service teacher focus group interviews and lecturer semi-structured interviews indicated two types of skill-related inhibitors. Both pre-service teachers and lecturers view ICT positively but lack ICT skills. Possessing adequate ICT skill is a prerequisite for using ICT to enhance GNH principles and values. A lack of pedagogical skill is another inhibitor that is preventing pre-service teachers and lecturers from using ICT to enhance GNH principles and values. One of the primary aims of *Educating for GNH* is to impart values such as creativity and critical thinking, which is only possible if one possesses strong pedagogical skills to use ICT to teach in the *transformation* domain. A lack of pedagogical skill to use ICT may hinder the ability to use ICT to provide opportunities for higher-order thinking skills that *Educating for GNH* is seeking to achieve.

Second, thematic analysis of pre-service teacher focus group interviews demonstrates that lack of ICT access is another inhibitor. Access to ICT is a problem specifically for pre-service teachers, as lecturers are provided with a dedicated laptop by the college. There are two types of problems related to access to hardware: access to computers, and access to Wi-Fi infrastructure. The problem of access to computers is due to an inadequate pre-service teacher-computer ratio, which is particularly aggravated when computers stop functioning due to virus infections. The other hardware-related problem is associated with the Wi-Fi infrastructure at the college. Although Wi-Fi

infrastructure is installed in and around the college campus, Wi-Fi cannot be accessed by pre-service teachers from many locations, including some of the classrooms and the pre-service teacher hostel areas. These access inhibitors impact on the creation of effective and efficient teaching and learning environments. Access to quality Internet is particularly a problem for pre-service teachers as many of them are not able to afford personal Internet connections. The thematic analysis suggests that slow Internet speed is a major inhibitor of the use of ICT. Since both pre-service teachers and lecturers depend heavily on Internet for teaching and learning resources, the slow Internet speed impacts on the quality of teaching and learning. Slow Internet speed can also cause equity issues because pre-service teachers who do not have access to personal Internet facilities may be disadvantaged, which is contrary to what *Educating for GNH* is aiming to achieve.

Third, certain policies adopted by the college impact on the ability of pre-service teachers and lecturer to use ICT and this represents another inhibitor. Pre-service teachers are not allowed to use hardware such as smart phones during class hours. This policy, although set for good reason, inhibits pre-service teacher learning as Wi-Fi signals are weak in some classrooms. This also has implications for lecturers to impart GNH values, such as empowerment, to pre-service teacher to be carried forward into their future classrooms. Since pre-service teachers are not allowed to use mobile devices, lecturers cannot make full use of the affordances of ICT. This can negatively impact on the creation of learner-centred environments. As some pre-service teachers have the tendency to abuse the ICT facilities by playing games and wasting time chatting on the social networking sites, social networking sites are blocked during class hours. For example, Facebook is blocked between 8 am and 4 pm every day but pre-service teachers claim that they also use these social networking sites for collaborative learning. Such an inhibitor to the use of ICT is likely to be contrary to what *Educating for GNH* is supposed to be instilling into the pre-service teachers consciousness: collaborating; sharing of ideas and knowledge; and making teaching more learner-friendly.

9.12 EDUCATING FOR GNH - IMPLICATIONS FOR THE STUDY SITE

The aim of *Educating for Gross National Happiness* is to bring about transformational changes to teaching and learning. This study has shown that ICT has the potential to enhance GNH principles and values because using ICT creates ambient learning environments where learning can be transformed from lecturer-driven to more

student-driven. This study has shown that ICT has the potential to assist in delivering GNH principles values at the college. However, the full potential of ICT is not being fully realised. This has four main implications for the study site.

The first implication is recognition of the importance of modelling by lecturers in how to use ICT to enhance GNH principles and values. Results of this study indicate that lecturers are not modelling how to use ICT enhance GNH principles and values in their day-to-day teaching of pre-service teachers. Evidence suggests that GNH principles values need to be explicitly taught. In the long term, failure to do this will make it difficult for pre-service teachers to know how to take the ideas of GNH into the broader Bhutan school system.

The second implication is the recognition of the need for lecturers to improve their pedagogical skills to use ICT. Since ICT has become one of the most useful teaching and learning tools, it is imperative that both lecturers and pre-service teachers are adequately trained in how to make effective use of ICT in particular, to enhance learning and how to use ICT to enhance GNH principles and values.

The third implication is recognition of the need for access to quality ICT infrastructures, such as high Internet speed and effective and reliable Wi-Fi facilities. Such infrastructure is necessary for using the online and Internet resources, which are heavily depended upon by both lecturers and pre-service teachers for teaching and learning at the college.

The fourth implication is recognition of the need for adequate technical support at the college. This is important as many of the computers in the pre-service teacher laboratories fail frequently often resulting in pre-service teachers not being able to use them. This may be disadvantaging many pre-service teachers who do not own personal ICT.

9.13 LIMITATIONS OF THE STUDY

As much as the study has shed light on how GNH principles and values can be enhanced through ICT, there were six main limitations of the study. First, the researcher acknowledges that not asking lecturers direct questions in the survey may have implications to the analysis because instead of asking lecturers their own perceptions of GNH, they were asked for their perceptions of pre-service teachers. Although this was done to avoid lecturers construing the situation as them being

tested on GNH knowledge, the procedure may have caused the lecturers to provide answers they thought the researcher was seeking rather than their real perceptions.

Second, the spread of participants for the lecturer semi-structured interviews did not have equal representation by sex as was initially planned, only three out of ten participants were females. This may have led to the researcher to draw biased inferences, impacting the quality of the findings.

Third, the composition of pre-service teachers was a mix of personalities, some of whom were outspoken while others were shy. Despite efforts to the contrary, the contributions made by the outspoken pre-service teachers dominating the focus group discussions may have impacted on the quality of the findings, as the quieter pre-service teachers may not have had their ideas heard.

Fourth, at the college where this research took place the majority of the pre-service teachers were studying for the BEd (Primary). The findings from this study based on a majority of the participants studying primary education may not be generalisable to other colleges, such as the Samtse College of Education in Bhutan, which trains secondary pre-service teachers.

Fifth, this study was undertaken at a college where the students were only studying in the Education discipline. The findings from the study may not be generalisable to other member colleges of the Royal University of Bhutan that educate students in other disciplines.

Finally, the study did not observe the actual practice by the pre-service teachers and lecturers using ICT in their daily teaching and learning. It is possible that biased conclusions may have been drawn because people's perceptions of a situation are not always representative of the reality. Thus pre-service teachers and lecturers may have made claims about their practice that may not have been substantiated if their practice had been observed.

9.14 RECOMMENDATIONS FOR FUTURE RESEARCH

The findings of the study identified four main issues that may be worth of further research. First, since this study was concerned with the role of ICT in enhancing GNH principles and values during pre-service teacher education further research might focus on the role ICT plays in enhancing GNH principles and values in educating students in other disciplines.

Second, since the findings of this study are based on surveys, focus group interviews, and semi-structured interviews, further research might focus on studying the actual teaching practice of using ICT to enhance GNH principles and values in college classrooms.

Third, since the findings of the study are only based on pre-service teacher perceptions while they are still studying in college. Further research is recommended in longitudinal studies of the pre-service teachers once they are in-service to determine their perceptions of how ICT can be used to enhance GNH principles and values in their own classrooms.

Fourth, since the findings of this study suggest that the use of social media tools is common and accepted amongst pre-service teachers and lecturers, further research is recommended to determine whether social media tools could be used to leverage support for more collaborative teaching and learning at the college as a means of enhancing GNH principles and values.

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APPENDICES

Appendix 1 – University of New England ethics approval.

Ethics Office
Research Development & Integrity
Research Division
Armidale NSW 2351
Australia
Phone *02 6773 3449*
Fax *02 6773 3543*
jo-ann.sozou@une.edu.au
www.une.edu.au/research-services

HUMAN RESEARCH ETHICS COMMITTEE

MEMORANDUM TO: Dr Mitchell Parkes, Mr Peter Fletcher, Dr Christine Reading, Mr Kinzang Lhendup, Mr Tandin Wangchuk & Mr Karma Chewang

School of Education

This is to advise you that the Human Research Ethics Committee has approved the following:

PROJECT TITLE:	Enriching Gross National Happiness through information and Communication Technology in pre-service teachers in Bhutan
APPROVAL No.:	HE14-029
COMMENCEMENT DATE:	06 March, 2014
APPROVAL VALID TO:	06 March, 2015
COMMENTS:	Nil. Conditions met in full

The Human Research Ethics Committee may grant approval for up to a maximum of three years. For approval periods greater than 12 months, researchers are required to submit an application for renewal at each twelve-month period. All researchers are required to submit a Final Report at the completion of their project. The Progress/Final Report Form is available at the following web address: http://www.une.edu.au/research-services/researchdevelopmentintegrity/ethics/human-ethics/hrecforms.php

The NHMRC National Statement on Ethical Conduct in Research Involving Humans requires that researchers must report immediately to the Human Research Ethics Committee anything that might affect ethical acceptance of the protocol. This includes adverse reactions of participants, proposed changes in the protocol, and any other unforeseen events that might affect the continued ethical acceptability of the project.

In issuing this approval number, it is required that all data and consent forms are stored in a secure location for a minimum period of five years. These documents may be required for compliance audit processes during that time. If the location at which data and documentation are retained is changed within that five year period, the Research Ethics Officer should be advised of the new location.

[redacted]

Jo-Ann Sozou
Secretary/Research Ethics Officer

06/03/2014 A14/31

Appendix 2 – Paro College of Education ethics approval.

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PARO COLLEGE OF EDUCATION
ROYAL UNIVERSITY OF BHUTAN
PARO: BHUTAN

PCE/Adm.(23)/2013-2014/941

January 10, 2013

Mr. Karma Chewang
PhD Student
University of New England
Armidale, NSW, Australia.

Sub: Approval to carry out research at Paro College of Education

Dear Karma,

Paro College of Education is pleased to hear about your proposal to carry out your action research on "Integration/application of ICT to enhance GNH in the pre-service teacher education in Bhutan" at this College of Education. Such a study conducted in the context of the Bhutanese education system will have a phenomenal positive impact in developing the quality of pre-service teacher education practices especially by weaving ICT within the larger developmental philosophy of Gross National Happiness.

Besides the involvement of the student teachers as your research participants, your plan of involving two of our faculty members as co-investigators in your proposed study is a very noble thought, which would also help in building the research profile and capacity of the College academics.

In this regard, Paro College of Education is pleased to grant the approval of carrying out your research in this College upon condition that you have the Ethics Approval from the University of New England, Armidale and strictly abide by those standards as stated in your application.

With kind regards.

[redacted]

(Rinchen Dorji)
Offtg. Director General

Copy to:

1. Dean of Research & Industrial Linkages, for information.
2. Office copy.

Director General
Paro College of Education
Royal University of Bhutan
Paro : Bhutan

Appendix 3 – Pre-service Teacher Web-based Survey

Default Question Block

Enriching Gross National Happiness through Information and Communication Technology in pre-service teachers in Bhutan

Student Consent

I (the participant) have read the information contained in the Participant Information Sheet and any questions I have asked have been answered to my satisfaction. I agree to participate in the online survey, realising that I may withdraw at any time without consequence nor do I need to provide any explanation if I decide not to participate or withdraw at any time.

I understand the web-based survey will be conducted anonymously and no identifying information will be collected nor will any attempt be made to identify me. I understand that research data gathered for the study will be published and give my consent for it to be used in this manner.

I understand that at the end of the survey that I will be given the option to elect to be a member of a focus group interview. If I elect to be part of this focus group, I understand that I may withdraw at any time without consequence nor do I need to provide any explanation if I decide not to participate or withdraw at any time.

I understand if I elect to take part in a focus group interview and I am quoted it will with an assumed name so I will not be able to be identified.

I give my permission to be recorded during this focus group interview acknowledging that this is solely to ensure the accuracy of the interview transcripts.

This project has been approved by the UNE Human Research Ethics Committee of the University of New England (Approval No HE14-029, Valid to 06/03/2015).

Please feel free to contact the research team with any questions about this research via the contact details below:

Karma Chewang Student Researcher School of Education University of New England Armidale, Australia kchewang@myune.edu.au +61 2 6773 2059	Dr Mitchell Parkes Principal Supervisor Lecturer, ICT Education School of Education University of New England Armidale, Australia mparkes2@une.edu.au +61 2 6773 5082

Should you have any complaints concerning the manner in which this research is conducted, please contact either:

Kezang Sherab Senior Lecturer Paro College of Education Royal University of Bhutan Email - kezangsherab@yahoo.com	The Research Ethics Officer at: Research Services University of New England Armidale, NSW 2351 Tel: (02) 6773 3449 Fax: (02) 6773 3543 Email: ethics@une.edu.au

Yes I give my consent ○ No I do not give my consent ○

PART A. DEMOGRAPHIC INFORMATION

My sex is

Male ○ Female ○

My age in years is:

18 ○ 19 ○ 20 ○ 21 ○ 22 ○ 23 ○ 24 ○ over 24 ○

I am enrolled in:

B.Ed (Primary) ○ B.Ed (Primary Dzongha) ○ B.Ed (Secondary) ○

Area of Specialization (Secondary only) (choose all that apply):

English ☐ Mathematics ☐ History ☐ Health and Physical Education ☐ ICT ☐ Science ☐

Year in college

First Year ○ Second Year ○ Third Year ○

Have you completed your teaching practice experience

Yes ○ No ○

PART B: SURVEY ITEMS

I believe I possess adequate knowledge about GNH principles and values

Strongly disagree ○ Disagree ○ Neither Agree nor Disagree ○ Agree ○ Strongly Agree ○

I believe GNH should be infused into my day-to-day teaching

Strongly disagree Disagree Neither Agree nor Disagree Agree Strongly Agree

○	○	○	○	○

I believe it is necessary for pre-service teacher curriculum in Bhutan to reflect GNH

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I believe ICT tools can make my teaching and learning more effective

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I believe the use of ICT tools make activities more efficient

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I believe ICT enhances the way I learn

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
☐	☐	☐	☐	☐

I believe ICT has the potential to make me a more imaginative student

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I believe ICT tools can help enhance creativity

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I believe ICT tools have the potential to effectively internalize GNH values

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I believe ICT can be an effective tool to foster GNH to better become part of our lives

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I believe ICT tools can make learning more enjoyable

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I believe ICT tools can make learning more relevant

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I believe GNH values are enhanced more efficiently using ICT tools

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I believe ICT is an efficient tool to enhance GNH values such as integrity

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I believe ICT is an efficient tool to enhance my motivation to learn

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I believe the use of ICT tools aid in enhancing my critical thinking skills

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I believe using ICT tools enhance my ability to collaborate efficiently

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I believe ICT tools possess the potential to make me become more reflective

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I believe ICT is a good tool to help me become more mindful about what I do

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I believe ICT is an effective tool to learn about media literacy

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I believe ICT is an effective tool to create conducive learning environments for learners

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I believe ICT has the potential to create life long learners

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I believe ICT is a good tool to engage students

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I believe using ICT tools can improve a learner's emotional well-being

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I believe ICT can make learning more efficient

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I believe ICT can improve quality of education

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I believe ICT can improve the academic performance of learners

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I believe using ICT has the potential to improve one's ability to teach

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I believe it possible to change learning from passive to active using ICT tools

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I believe using ICT can empower a learner

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

PART C: PERSONAL PERCEPTIONS OF ICT

I know how to solve my own technical problems

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I learn technology easily

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I know how to choose technologies that enhance students' learning for a lesson

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I keep up with new technologies

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I frequently play around with the technology

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

○	○	○	○	○

I know how choose appropriate technologies to enhance teaching approaches for a lesson

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I know a lot about different technologies

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I have the technical skills needed to use technology

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I know how to choose appropriate technologies that enhance the development of GNH values in my lessons

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I can think critically about how to use technology in the classroom

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I am confident to customize the technology that I own to different teaching activities

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I am able to select appropriate technologies to use in my classroom to enhance what I teach

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I know how to use strategies that combine content, technologies and teaching approaches

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I possess adequate skills to provide leadership in helping others to coordinate the use of content, technologies and teaching approaches

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I know how to choose technologies that can enhance the content for a lesson

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I can appropriately combine content, ICT, and teaching approaches in a classroom lesson

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I am able to use strategies that combine content, ICT, and teaching approaches

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I know how to select ICT that enhances what I teach

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

Would you be prepared to take part in a focus group interview?

Yes	No
○	○

Could you please provide your email address so we can send you further information

Appendix 4 – Lecturer Web-based Survey

Default Question Block

Enriching Gross National Happiness through Information and Communication Technology in pre-service teachers in Bhutan

Lecturer Consent

I (the participant) have read the information contained in the Participant Information Sheet and any questions I have asked have been answered to my satisfaction. I agree to participate in the online survey, realising that I may withdraw at any time without consequence nor do I need to provide any explanation if I decide not to participate or withdraw at any time.

I understand the web-based survey will be conducted anonymously and no identifying information will be collected nor will any attempt be made to identify me. I understand that research data gathered for the study will be published and give my consent for it to be used in this manner.

I understand that at the end of the survey that I will be given the option to elect to be a member of a focus group interview. If I elect to be part of this focus group, I understand that I may withdraw at any time without consequence nor do I need to provide any explanation if I decide not to participate or withdraw at any time.

I understand if I elect to take part in a focus group interview and I am quoted it will with an assumed name so I will not be able to be identified.

I give my permission to be recorded during this focus group interview acknowledging that this is solely to ensure the accuracy of the interview transcripts.

This project has been approved by the UNE Human Research Ethics Committee of the University of New England (Approval No HE14-029, Valid to 06/03/2015).

Please feel free to contact the research team with any questions about this research via the contact details below:

Karma Chewang Student Researcher School of Education University of New England Armidale, Australia kchewang@myune.edu.au +61 2 6773 2059	Dr Mitchell Parkes Principal Supervisor Lecturer, ICT Education School of Education University of New England Armidale, Australia mparkes2@une.edu.au +61 2 6773 5082

Should you have any complaints concerning the manner in which this research is conducted, please contact either:

Kezang Sherab Senior Lecturer Paro College of Education Royal University of Bhutan Email - kezangsherab@yahoo.com	The Research Ethics Officer at: Research Services University of New England Armidale, NSW 2351 Tel: (02) 6773 3449 Fax: (02) 6773 3543 Email: ethics@une.edu.au

Yes I give my consent ○ No i do not give my consent ○

Part A Demographic Information

My sex is

Male	Female
○	○

My age in years is:

25 or les	26-30	31-35	36-40	41-45	46-50	51 or over
○	○	○	○	○	○	○

Area of Specialisation (please choose all that apply):

English	Dzongkha	Mathematics	History	Health and Physical Education	ICT	Science	Professional Studies	Geography	Social Studies
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Teaching experiences

5 years or less	5-10	11-15	16-20	21-25	26-30	31 or over
○	○	○	○	○	○	○

Students currently taught

Frist Year	Second Year	Third Year	Fourth Year
○	○	○	○

Part B Lecturer Perception of Students

Could you please rate the following with respect to the students you teach

I am confident my students possess adequate knowledge about GNH principles and values

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I am confident my students believe GNH should be infused into my day-to-day teaching

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I am confident my students believe it is necessary for the pre-service teacher curriculum in Bhutan to reflect GNH

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

I am confident my students believe ICT tools can make my teaching and learning more effective

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

I am confident my students believe the use of ICT tools make learning activities more efficient

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

I am confident my students believe ICT enhances the way they learn

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

I am confident my students believe ICT has the potential to make them more imaginative students

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

I am confident my students believe ICT tools can help enhance creativity

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

I am confident my students believe ICT tools have the potential to effectively internalise GNH values

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

I am confident my students believe ICT can be an effective tool to foster GNH to better become part of their lives

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

I am confident my students believe ICT tools can make learning more enjoyable

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

I am confident my students believe ICT tools can make learning more relevant

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I am confident my students believe GNH values are enhanced more efficiently using ICT tools

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I am confident my students believe ICT is an efficient tool to enhance GNH values such as integrity

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I am confident my students believe ICT is an efficient tool to enhance their motivation to learn

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I am confident my students believe the use of ICT tools aid in enhancing critical thinking skills

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I am confident my students believe that using ICT tools enhance student ability to collaborate efficiently

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I am confident my students believe ICT tools possess the potential to make learners become more reflective

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I am confident my students believe ICT is a good tool to help one become more mindful about what one does

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I am confident my students believe ICT is an effective tool to learn about media literacy

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I am confident my students believe ICT is an effective tool to create conducive learning environments for learners

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I am confident my students believe ICT has the potential to create life long learners

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I am confident my students believe ICT is a good tool to engage students

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I am confident my students believe using ICT tools can improve a students emotional well-being

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I am confident my students believe ICT can make learning more efficient

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I am confident my students believe ICT can improve the quality of education

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I am confident my students believe ICT can improve the academic performance of learners

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I am confident my students believe using ICT has the potential to improve one’s ability to teach

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I am confident my students believe it is possible to change learning from passive to active using ICT tools

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I am confident my students believe using ICT can empower a learner

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

Part C: Personal Perceptions of ICT

Could you please rate the following with respect to your own perceptions.

I know how to solve my own technical problems

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I learn technology easily

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I know how to choose technologies that enhance student learning for a lesson

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I keep up with new technologies

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I frequently play around with the technology

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I know how choose appropriate technologies to enhance teaching approaches for a lesson

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I know a lot about different technologies

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I have the technical skills needed to use technology

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I know how to choose appropriate technologies that enhance the development of GNH values in my lessons

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I think critically about how to use technology in the classroom

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I am confident to customise the technology that I own to different teaching activities

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I am able to select appropriate technologies to use in my classroom to enhance what I teach

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I know how to use strategies that combine content, technologies and teaching approaches

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I possess adequate skills to provide leadership in helping others to coordinate the use of content, technologies and teaching approaches

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

I possess adequate skills to provide leadership in helping others to coordinate the use of content, technologies and teaching approaches

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I know how to choose technologies that can enhance the content for a lesson

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I can appropriately combine content, ICT, and teaching approaches in a classroom lesson

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I am able to use strategies that combine content, ICT, and teaching approaches

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

I know how to select ICT that enhances what I teach

Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
○	○	○	○	○

Would you be prepared to take part in a focus group interview?

Yes	No
○	○

Could you please provide your email address so we can send you further information

Appendix 5 - Overall research candidature plan

Research stage	**Activities**
Preparation for Confirmation of Candidature (Nov 2012 – Jan 2013)	Literature search • Bhutanese education system • Pre-service teacher in Bhutan • GNH and Educating for GNH • ICT and the Bhutanese government policy • ICT in education in Bhutan • ICT in education (international) • ICT in pre-service teacher education • Theoretical framework • Preliminary research question (proposed) • Develop research proposal
Negotiation with PCE (Jan – Feb 2014)	• Email communication for approval • Discussion with academics selection of methods
Confirmation of candidature (Feb 2014)	
Approval from PCE	Refer Appendix 1 for letter of approval
UNE ethics approval March 2014	Refer Appendix 1 for letter of approval
Data collection plan -Survey and interviews (March – April 2014)	• Sampling plan • Research instrument development • Pilot research instruments • Analyse pilot data • Finalization of research instruments • Pre-survey to be run
Visit research site (Aug – Sept 2014)	Refer Table 4.6 for detail
Preparation for data analysis (Oct 2014 – Jan 2015)	• Download surveys into SPSS • Interview data transcription (lecturer) • Interview data transcription (Pre-service teacher)
Researcher on leave of absence from the university (Feb – Oct 2015)	
Data analysis (Oct – Nov 2015)	Lecturer survey analysis • T-test • ANOVA
Dec 2015	Pre-service teacher survey analysis • T-test • ANOVA
Jan – April 2016	Thematic analysis
May – Sept 2016	Reporting survey results
Writing up (Oct 2016)	Final draft report
Nov 2016	Review draft with supervisors
Dec 2016	Submission of thesis

Appendix 6 - Pre-service teacher web-based survey results

Table A.6.1 - Independent t-tests - male and female pre-service teacher perceptions

Item	t	df	sig.
GNH and GNH in Education			
I believe I possess adequate knowledge about GNH principles and values	2.46	647	0.01*
I believe GNH should be infused into my day-to-day teaching	1.16	664	0.25
I believe it is necessary for pre-service teacher curriculum in Bhutan to reflect GNH	0.37	661	0.71
ICT in Education			
I believe ICT tools can make my teaching and learning more effective	1.49	658	0.14
I believe the use of ICT tools make activities more efficient	0.05	661	0.96
I believe ICT enhances the way I learn	2.04	657	0.04*
I believe ICT is an effective tool to create conducive learning environments for learners	1.49	660	0.14
I believe ICT is a good tool to engage students	1.28	661	0.20
I believe ICT can make learning more efficient	-0.17	628	0.87
I believe ICT can improve quality of education	-0.09	655	0.93
I believe ICT can improve the academic performance of learners	1.02	653	0.31
I believe using ICT has the potential to improve one's ability to teach	0.74	658	0.46
I believe it possible to change learning from passive to active using ICT tools	0.76	649	0.45
ICT enhancing GNH principles and values			
I believe ICT has the potential to make me a more imaginative student	1.37	657	0.17
I believe ICT tools can help enhance creativity	0.70	656	0.48
I believe ICT tools have the potential to effectively internalize GNH values	2.34	650	0.02*
I believe ICT can be an effective tool to foster GNH to better become part of our lives	-0.17	659	0.87
I believe ICT tools can make learning more enjoyable	0.49	658	0.62
I believe ICT tools can make learning more relevant	-1.07	657	0.29
I believe GNH values are enhanced more efficiently using ICT tools	1.90	658	0.06
I believe ICT is an efficient tool to enhance GNH values such as integrity	1.58	656	0.12
I believe ICT is an efficient tool to enhance my motivation to learn	1.01	656	0.31
I believe the use of ICT tools aid in enhancing my critical thinking skills	0.75	654	0.45
I believe using ICT tools enhance my ability to collaborate efficiently	1.98	651	0.05
I believe ICT tools possess the potential to make me become more reflective	1.74	657	0.08
I believe ICT is a good tool to help me become more mindful about what I do	0.07	653	0.95
I believe ICT is an effective tool to learn about media literacy	0.36	657	0.72
I believe ICT has the potential to create life-long learners	0.78	654	0.44
I believe using ICT tools can improve a learner's emotional well-being	3.02	650	0.03*
I believe using ICT can empower a learner	0.65	656	0.52

* Significant: p <.05

Table A.6.2 - ANOVA - Pre-service teacher perceptions according to age range

GNH and GNH in Education

		Sum of Squares	df	Mean Square	F	Sig.
I believe I possess adequate knowledge about GNH principles and values	Between Groups	2.471	3	.824	1.810	.144
	Within Groups	302.049	664	.455		
	Total	304.519	667			

I believe GNH should be infused into my day-to-day teaching	Between Groups	3.487	3	1.162	2.708	.044
	Within Groups	285.020	664	.429		
	Total	288.507	667			
I believe it is necessary for pre-service teacher curriculum in Bhutan to reflect GNH	Between Groups	1.215	3	.405	1.084	.355
	Within Groups	247.032	661	.374		
	Total	248.247	664			

ICT in Education

		Sum of Squares	df	Mean Square	F	Sig.
I believe ICT tools can make my teaching and learning more effective	Between Groups	2.147	3	.716	1.816	.143
	Within Groups	259.316	658	.394		
	Total	261.462	661			
I believe the use of ICT tools make activities more efficient	Between Groups	.881	3	.294	.744	.526
	Within Groups	261.113	661	.395		
	Total	261.994	664			
I believe ICT enhances the way I learn	Between Groups	1.907	3	.636	1.552	.200
	Within Groups	269.052	657	.410		
	Total	270.959	660			
I believe ICT is an effective tool to create conducive learning environments for learners	Between Groups	.573	3	.191	.488	.691
	Within Groups	258.505	660	.392		
	Total	259.078	663			
I believe ICT is a good tool to engage students	Between Groups	.926	3	.309	.718	.542
	Within Groups	284.358	661	.430		
	Total	285.284	664			
I believe ICT can make learning more efficient	Between Groups	.783	3	.261	.803	.493
	Within Groups	211.510	650	.325		
	Total	212.294	653			
I believe ICT can improve quality of education	Between Groups	.633	3	.211	.397	.755
	Within Groups	348.505	655	.532		
	Total	349.138	658			

I believe ICT can improve the academic performance of learners	Between Groups	.492	3	.164	.312	.816
	Within Groups	342.899	653	.525		
	Total	343.391	656			
I believe using ICT has the potential to improve one's ability to teach	Between Groups	4.691	3	1.564	4.135	.006*
	Within Groups	248.849	658	.378		
	Total	253.541	661			
I believe it possible to change learning from passive to active using ICT tools	Between Groups	1.592	3	.531	1.316	.268
	Within Groups	261.710	649	.403		
	Total	263.302	652			

ICT enhancing GNH principles and values

		Sum of Squares	df	Mean Square	F	Sig.
I believe ICT has the potential to make me a more imaginative student	Between Groups	2.261	3	.754	1.484	.218
	Within Groups	333.757	657	.508		
	Total	336.018	660			
I believe ICT tools can help enhance creativity	Between Groups	1.233	3	.411	.776	.508
	Within Groups	347.349	656	.529		
	Total	348.582	659			
I believe ICT tools have the potential to effectively internalize GNH values	Between Groups	.849	3	.283	.646	.586
	Within Groups	287.327	656	.438		
	Total	288.176	659			
I believe ICT can be an effective tool to foster GNH to better become part of our lives	Between Groups	.839	3	.280	.648	.585
	Within Groups	284.519	659	.432		
	Total	285.357	662			
I believe ICT tools can make learning more enjoyable	Between Groups	.699	3	.233	.715	.543
	Within Groups	214.256	658	.326		
	Total	214.955	661			
I believe ICT tools can make learning more relevant	Between Groups	.599	3	.200	.646	.586
	Within Groups	203.110	657	.309		
	Total	203.710	660			

I believe GNH values are enhanced more efficiently using ICT tools	Between Groups	3.854	3	1.285	2.189	.088
	Within Groups	386.256	658	.587		
	Total	390.110	661			
I believe ICT is an efficient tool to enhance GNH values such as integrity	Between Groups	1.869	3	.623	1.565	.197
	Within Groups	261.129	656	.398		
	Total	262.998	659			
I believe ICT is an efficient tool to enhance my motivation to learn	Between Groups	.384	3	.128	.327	.806
	Within Groups	257.216	656	.392		
	Total	257.600	659			
I believe the use of ICT tools aid in enhancing my critical thinking skills	Between Groups	1.802	3	.601	1.099	.349
	Within Groups	357.463	654	.547		
	Total	359.264	657			
I believe using ICT tools enhance my ability to collaborate efficiently	Between Groups	.573	3	.191	.478	.698
	Within Groups	260.388	651	.400		
	Total	260.962	654			
I believe ICT tools possess the potential to make me become more reflective	Between Groups	.924	3	.308	.727	.536
	Within Groups	278.075	657	.423		
	Total	278.998	660			
I believe ICT is a good tool to help me become more mindful about what I do	Between Groups	3.656	3	1.219	2.184	.089
	Within Groups	364.317	653	.558		
	Total	367.973	656			
I believe ICT is an effective tool to learn about media literacy	Between Groups	.029	3	.010	.030	.993
	Within Groups	214.328	657	.326		
	Total	214.357	660			
I believe ICT has the potential to create life-long learners	Between Groups	.662	3	.221	.446	.720
	Within Groups	323.611	654	.495		
	Total	324.274	657			
I believe using ICT	Between Groups	3.040	3	1.013	1.760	.154

tools can improve a learner's emotional well-being	Within Groups	379.377	659	.576		
	Total	382.416	662			
I believe using ICT can empower a learner	Between Groups	1.176	3	.392	1.221	.301
	Within Groups	210.551	656	.321		
	Total	211.727	659			

* Significant: p <.05

Table A.6.3 - ANOVA - Pre-service teachers' perceptions according to enrolment

GNH and GNH in Education

		Sum of Squares	df	Mean Square	F	Sig.
I believe I possess adequate knowledge about GNH principles and values	Between Groups	5.386	2	2.693	6.012	.003*
	Within Groups	299.252	668	.448		
	Total	304.638	670			
I believe GNH should be infused into my day-to-day teaching	Between Groups	3.973	2	1.987	4.647	.010*
	Within Groups	285.550	668	.427		
	Total	289.523	670			
I believe it is necessary for pre-service teacher curriculum in Bhutan to reflect GNH	Between Groups	.004	2	.002	.006	.994
	Within Groups	248.912	665	.374		
	Total	248.916	667			

ICT in Education

		Sum of Squares	df	Mean Square	F	Sig.
I believe ICT tools can make my teaching and learning more effective	Between Groups	.412	2	.206	.521	.594
	Within Groups	261.807	662	.395		
	Total	262.220	664			
I believe the use of ICT tools make activities more efficient	Between Groups	1.286	2	.643	1.635	.196
	Within Groups	261.582	665	.393		
	Total	262.868	667			
I believe ICT enhances the way I learn	Between Groups	.087	2	.044	.106	.899
	Within Groups	271.545	661	.411		

	Total	271.633	663			
I believe ICT is an effective tool to create conducive learning environments for learners	Between Groups	.418	2	.209	.533	.587
	Within Groups	260.736	664	.393		
	Total	261.154	666			
I believe ICT is a good tool to engage students	Between Groups	.766	2	.383	.883	.414
	Within Groups	288.324	665	.434		
	Total	289.090	667			
I believe ICT can make learning more efficient	Between Groups	.789	2	.395	1.216	.297
	Within Groups	212.209	654	.324		
	Total	212.998	656			
I believe ICT can improve quality of education	Between Groups	.988	2	.494	.933	.394
	Within Groups	348.874	659	.529		
	Total	349.863	661			
I believe ICT can improve the academic performance of learners	Between Groups	3.679	2	1.840	3.548	.029*
	Within Groups	340.652	657	.518		
	Total	344.332	659			
I believe using ICT has the potential to improve one's ability to teach	Between Groups	.208	2	.104	.271	.763
	Within Groups	254.042	662	.384		
	Total	254.250	664			
I believe it possible to change learning from passive to active using ICT tools	Between Groups	.219	2	.110	.271	.763
	Within Groups	264.293	653	.405		
	Total	264.512	655			

ICT enhancing GNH principles and values

		Sum of Squares	df	Mean Square	F	Sig.
I believe ICT has the potential to make me a more imaginative student	Between Groups	.029	2	.015	.029	.972
	Within Groups	336.704	661	.509		
	Total	336.733	663			
I believe ICT tools can help enhance creativity	Between Groups	5.384	2	2.692	5.167	.006
	Within Groups	343.904	660	.521		
	Total	349.288	662			
I believe ICT tools have the potential to effectively internalize GNH values	Between Groups	4.266	2	2.133	4.944	.007
	Within Groups	284.748	660	.431		
	Total	289.014	662			
I believe ICT can be an effective tool to foster GNH to better become part of our lives	Between Groups	5.118	2	2.559	6.030	.003*
	Within Groups	281.344	663	.424		
	Total	286.462	665			
I believe ICT tools can make learning more enjoyable	Between Groups	.357	2	.178	.548	.578
	Within Groups	215.322	662	.325		
	Total	215.678	664			
I believe ICT tools can make learning more relevant	Between Groups	.124	2	.062	.201	.818
	Within Groups	204.280	661	.309		
	Total	204.404	663			
I believe GNH values are enhanced more efficiently using ICT tools	Between Groups	5.124	2	2.562	4.391	.013*
	Within Groups	386.260	662	.583		
	Total	391.383	664			
I believe ICT is an efficient tool to enhance GNH values such as integrity	Between Groups	2.095	2	1.047	2.622	.073
	Within Groups	263.655	660	.399		
	Total	265.750	662			
I believe ICT is an efficient tool to enhance my motivation to learn	Between Groups	.846	2	.423	1.084	.339
	Within Groups	257.474	660	.390		
	Total	258.320	662			
I believe the use of	Between Groups	1.668	2	.834	1.530	.217

ICT tools aid in enhancing my critical thinking skills	Within Groups	358.665	658	.545		
	Total	360.333	660			
I believe using ICT tools enhance my ability to collaborate efficiently	Between Groups	.638	2	.319	.796	.451
	Within Groups	262.324	655	.400		
	Total	262.962	657			
I believe ICT tools possess the potential to make me become more reflective	Between Groups	3.652	2	1.826	4.368	.013*
	Within Groups	276.348	661	.418		
	Total	280.000	663			
I believe ICT is a good tool to help me become more mindful about what I do	Between Groups	9.302	2	4.651	8.471	.000*
	Within Groups	360.735	657	.549		
	Total	370.036	659			
I believe ICT is an effective tool to learn about media literacy	Between Groups	.720	2	.360	1.109	.331
	Within Groups	214.520	661	.325		
	Total	215.239	663			
I believe ICT has the potential to create life-long learners	Between Groups	1.629	2	.815	1.635	.196
	Within Groups	327.929	658	.498		
	Total	329.558	660			
I believe using ICT tools can improve a learner's emotional well-being	Between Groups	13.973	2	6.987	12.498	.000*
	Within Groups	370.621	663	.559		
	Total	384.595	665			
I believe using ICT can empower a learner	Between Groups	.343	2	.172	.534	.587
	Within Groups	212.167	660	.321		
	Total	212.510	662			

* Significant: p <.05

Table A.6.4 - ANOVA - pre-service teacher perceptions according to year of study

GNH and GNH in Education

		Sum of Squares	df	Mean Square	F	Sig.
I believe I possess adequate knowledge about GNH principles and values	Between Groups	2.657	3	.886	1.957	.119
	Within Groups	298.260	659	.453		
	Total	300.917	662			
I believe GNH should be infused into my day-to-day teaching	Between Groups	1.834	3	.611	1.421	.235
	Within Groups	283.445	659	.430		
	Total	285.279	662			
I believe it is necessary for pre-service teacher curriculum in Bhutan to reflect GNH	Between Groups	.817	3	.272	.726	.537
	Within Groups	246.181	656	.375		
	Total	246.998	659			

ICT in Education

		Sum of Squares	df	Mean Square	F	Sig.
I believe ICT tools can make my teaching and learning more effective	Between Groups	1.094	3	.365	.919	.431
	Within Groups	259.092	653	.397		
	Total	260.186	656			
I believe the use of ICT tools make activities more efficient	Between Groups	3.351	3	1.117	2.851	.037*
	Within Groups	257.049	656	.392		
	Total	260.400	659			
I believe ICT enhances the way I learn	Between Groups	2.977	3	.992	2.438	.064
	Within Groups	265.413	652	.407		
	Total	268.390	655			
I believe ICT is an effective tool to create conducive learning environments for learners	Between Groups	2.059	3	.686	1.746	.156
	Within Groups	257.528	655	.393		
	Total	259.587	658			
I believe ICT is a good tool to engage students	Between Groups	3.378	3	1.126	2.603	.051
	Within Groups	283.766	656	.433		
	Total	287.144	659			

I believe ICT can make learning more efficient	Between Groups	3.666	3	1.222	3.803	.010*
	Within Groups	207.265	645	.321		
	Total	210.931	648			
I believe ICT can improve quality of education	Between Groups	1.281	3	.427	.803	.493
	Within Groups	345.827	650	.532		
	Total	347.109	653			
I believe ICT can improve the academic performance of learners	Between Groups	5.081	3	1.694	3.263	.021*
	Within Groups	337.367	650	.519		
	Total	342.448	653			
I believe using ICT has the potential to improve one's ability to teach	Between Groups	4.904	3	1.635	4.337	.005*
	Within Groups	246.110	653	.377		
	Total	251.014	656			
I believe it possible to change learning from passive to active using ICT tools	Between Groups	2.749	3	.916	2.273	.079
	Within Groups	259.695	644	.403		
	Total	262.444	647			

ICT enhancing GNH principles and values

		Sum of Squares	df	Mean Square	F	Sig.
I believe ICT has the potential to make me a more imaginative student	Between Groups	4.723	3	1.574	3.128	.025*
	Within Groups	328.117	652	.503		
	Total	332.840	655			
I believe ICT tools can help enhance creativity	Between Groups	5.822	3	1.941	3.713	.011*
	Within Groups	340.254	651	.523		
	Total	346.076	654			
I believe ICT tools have the potential to effectively internalize GNH values	Between Groups	4.829	3	1.610	3.746	.011*
	Within Groups	280.121	652	.430		
	Total	284.950	655			
I believe ICT can be an effective tool to foster GNH to better become part of our lives	Between Groups	2.836	3	.945	2.220	.085
	Within Groups	278.509	654	.426		
	Total	281.345	657			

I believe ICT tools can make learning more enjoyable	Between Groups	2.132	3	.711	2.195	.087
	Within Groups	211.415	653	.324		
	Total	213.546	656			
I believe ICT tools can make learning more relevant	Between Groups	1.428	3	.476	1.553	.200
	Within Groups	199.887	652	.307		
	Total	201.316	655			
I believe GNH values are enhanced more efficiently using ICT tools	Between Groups	1.984	3	.661	1.122	.339
	Within Groups	385.621	654	.590		
	Total	387.605	657			
I believe ICT is an efficient tool to enhance GNH values such as integrity	Between Groups	.981	3	.327	.816	.485
	Within Groups	261.238	652	.401		
	Total	262.220	655			
I believe ICT is an efficient tool to enhance my motivation to learn	Between Groups	1.368	3	.456	1.170	.320
	Within Groups	253.618	651	.390		
	Total	254.986	654			
I believe the use of ICT tools aid in enhancing my critical thinking skills	Between Groups	3.603	3	1.201	2.211	.086
	Within Groups	352.587	649	.543		
	Total	356.190	652			
I believe using ICT tools enhance my ability to collaborate efficiently	Between Groups	.450	3	.150	.372	.773
	Within Groups	260.475	646	.403		
	Total	260.925	649			
I believe ICT tools possess the potential to make me become more reflective	Between Groups	2.352	3	.784	1.857	.136
	Within Groups	275.642	653	.422		
	Total	277.994	656			
I believe ICT is a good tool to help me become more mindful about what I do	Between Groups	7.883	3	2.628	4.739	.003*
	Within Groups	359.275	648	.554		
	Total	367.158	651			
I believe ICT is an effective tool to learn about media	Between Groups	2.146	3	.715	2.214	.085
	Within Groups	210.962	653	.323		

literacy	Total	213.108	656			
I believe ICT has the potential to create life-long learners	Between Groups	3.621	3	1.207	2.427	.064
	Within Groups	322.765	649	.497		
	Total	326.386	652			
I believe using ICT tools can improve a learner's emotional well-being	Between Groups	2.359	3	.786	1.362	.253
	Within Groups	377.756	654	.578		
	Total	380.116	657			
I believe using ICT can empower a learner	Between Groups	.625	3	.208	.645	.586
	Within Groups	210.282	651	.323		
	Total	210.907	654			

* Significant: p <.05

Table A.6.5 - Independent t-tests - male and female pre-service teacher TPACK

Item	t	df	sig.
Technological Knowledge (TK)			
I know how to solve my own technical problems	6.82	638	0.000*
I learn technology easily	4.36	637	0.000*
I keep up with new technologies	3.94	632	0.000*
I frequently play around with the technology	3.70	619	0.000*
I know a lot about different technologies	5.25	632	0.000*
I have the technical skills needed to use technology	5.46	635	0.000*
Technological Pedagogical Knowledge (TPK)			
I know how to choose technologies that enhance students' learning for a lesson	4.72	618	0.000*
I know how choose appropriate technologies to enhance teaching approaches for a lesson	4.48	631	0.000*
I can think critically about how to use technology in the classroom	4.59	627	0.000*
I am confident to customize the technology that I own to different teaching activities	7.16	623	0.000*
I am able to select appropriate technologies to use in my classroom to enhance what I teach	4.84	615	0.000*
Technological Content Knowledge (TCK)			
I know how to choose technologies that enhance the development of GNH values in my lessons	4.21	631	0.000*
I know how to choose technologies that can enhance the content for a lesson	5.84	621	0.000*
I know how to select ICT that enhances what I teach	3.04	630	0.002*
Technological Pedagogical Content Knowledge (TPACK)			
I know how to use strategies that combine content, technologies and teaching approaches	6.76	622	0.000*
I possess adequate skills to provide leadership in helping others	6.29	614	0.000*
I am able to use strategies that combine content, ICT, and teaching approaches	5.62	618	0.000*
I can appropriately combine content, ICT, and teaching approaches in a classroom lesson	5.09	590	0.000*

* Significant: p <.05

Table A.6.6 ANOVA - pre-service teacher TPACK according to age range

Technological Knowledge (TK)

		Sum of Squares	df	Mean Square	F	Sig.
I know how to solve my own technical problems	Between Groups	13.162	3	4.387	4.973	.002*
	Within Groups	563.709	639	.882		
	Total	576.871	642			
I learn technology easily	Between Groups	.175	3	.058	.069	.976
	Within Groups	536.636	638	.841		
	Total	536.812	641			
I keep up with new technologies	Between Groups	6.215	3	2.072	3.019	.029*
	Within Groups	437.098	637	.686		
	Total	443.314	640			
I frequently play around with the technology	Between Groups	.647	3	.216	.327	.806
	Within Groups	421.947	639	.660		
	Total	422.594	642			
I know a lot about different technologies	Between Groups	5.229	3	1.743	2.182	.089
	Within Groups	506.545	634	.799		
	Total	511.774	637			
I have the technical skills needed to use technology	Between Groups	1.167	3	.389	.502	.681
	Within Groups	493.419	636	.776		
	Total	494.586	639			

Technological Pedagogical Knowledge (TPK)

		Sum of Squares	df	Mean Square	F	Sig.
I know how choose appropriate technologies to enhance teaching approaches for a lesson	Between Groups	7.729	3	2.576	3.665	.012*
	Within Groups	448.546	638	.703		
	Total	456.276	641			
I know how to choose technologies that enhance students' learning for a lesson	Between Groups	3.476	3	1.159	2.056	.105
	Within Groups	357.208	634	.563		
	Total	360.683	637			

I can think critically about how to use technology in the classroom	Between Groups	5.543	3	1.848	2.874	.036*
	Within Groups	410.133	638	.643		
	Total	415.676	641			
I am confident to customize the technology that I own to different teaching activities	Between Groups	15.019	3	5.006	7.641	.000*
	Within Groups	416.045	635	.655		
	Total	431.064	638			
I am able to select appropriate technologies to use in my classroom to enhance what I teach	Between Groups	7.944	3	2.648	4.310	.005*
	Within Groups	390.097	635	.614		
	Total	398.041	638			

Technological Content Knowledge (TCK)

		Sum of Squares	df	Mean Square	F	Sig.
I know how to choose appropriate technologies that enhance the development of GNH values in my lessons	Between Groups	9.266	3	3.089	4.515	.004*
	Within Groups	433.060	633	.684		
	Total	442.327	636			
I know how to choose technologies that can enhance the content for a lesson	Between Groups	4.576	3	1.525	2.699	.045*
	Within Groups	361.690	640	.565		
	Total	366.266	643			
I know how to select ICT that enhances what I teach	Between Groups	7.939	3	2.646	4.733	.003*
	Within Groups	356.174	637	.559		
	Total	364.112	640			

Technological Pedagogical Content Knowledge (TPACK)

		Sum of Squares	df	Mean Square	F	Sig.
I know how to use strategies that combine content, technologies and teaching approaches	Between Groups	19.300	3	6.433	10.354	.000*
	Within Groups	392.061	631	.621		
	Total	411.361	634			
I possess adequate skills to provide leadership in	Between Groups	7.083	3	2.361	3.414	.017*
	Within Groups	438.428	634	.692		

helping others to coordinate the use of content, technologies and teaching approaches	Total	445.511	637			
I am able to use strategies that combine content, ICT, and teaching approaches	Between Groups	8.644	3	2.881	4.978	.002*
	Within Groups	367.575	635	.579		
	Total	376.219	638			
I can appropriately combine content, ICT, and teaching approaches in a classroom lesson	Between Groups	5.775	3	1.925	1.686	.169
	Within Groups	721.558	632	1.142		
	Total	727.333	635			

Table A.6.7 - ANOVA - Pre-service teacher TPACK according to enrolment

Technological Knowledge (TK)

		Sum of Squares	df	Mean Square	F	Sig.
I know how to solve my own technical problems	Between Groups	8.007	2	4.004	4.502	.011*
	Within Groups	570.870	642	.889		
	Total	578.878	644			
I learn technology easily	Between Groups	9.750	2	4.875	5.878	.003*
	Within Groups	531.628	641	.829		
	Total	541.379	643			
I keep up with new technologies	Between Groups	3.782	2	1.891	2.726	.066
	Within Groups	444.034	640	.694		
	Total	447.816	642			
I frequently play around with the technology	Between Groups	3.920	2	1.960	2.961	.052
	Within Groups	424.865	642	.662		
	Total	428.784	644			
I know a lot about different technologies	Between Groups	6.774	2	3.387	4.255	.015*
	Within Groups	507.069	637	.796		
	Total	513.844	639			
I have the technical skills needed to use technology	Between Groups	10.639	2	5.319	6.994	.001*
	Within Groups	486.023	639	.761		
	Total	496.662	641			

Technological Pedagogical Knowledge (TPK)

		Sum of Squares	df	Mean Square	F	Sig.
I know how to choose technologies that enhance students' learning for a lesson	Between Groups	1.916	2	.958	1.691	.185
	Within Groups	360.820	637	.566		
	Total	362.736	639			
I know how choose appropriate technologies to enhance teaching approaches for a lesson	Between Groups	4.238	2	2.119	2.988	.051
	Within Groups	454.607	641	.709		
	Total	458.845	643			
I can think critically about how to use technology in the classroom	Between Groups	2.332	2	1.166	1.796	.167
	Within Groups	415.484	640	.649		
	Total	417.816	642			
I am confident to customize the technology that I own to different teaching activities	Between Groups	5.833	2	2.917	4.345	.013*
	Within Groups	428.217	638	.671		
	Total	434.050	640			
I am able to select appropriate technologies to use in my classroom to enhance what I teach	Between Groups	3.339	2	1.669	2.685	.069
	Within Groups	396.693	638	.622		
	Total	400.031	640			

Technological Content Knowledge (TCK)

		Sum of Squares	df	Mean Square	F	Sig.
I know how to choose appropriate technologies that enhance the development of GNH values in my lessons	Between Groups	4.988	2	2.494	3.620	.027*
	Within Groups	438.188	636	.689		
	Total	443.177	638			
I know how to choose technologies that can enhance the content for a lesson	Between Groups	5.598	2	2.799	4.986	.007*
	Within Groups	360.961	643	.561		
	Total	366.559	645			
I know how to select ICT that enhances what I teach	Between Groups	2.537	2	1.269	2.232	.108
	Within Groups	363.761	640	.568		
	Total	366.299	642			

Technological Pedagogical Content Knowledge (TPACK)

		Sum of Squares	df	Mean Square	F	Sig.
I know how to use strategies that combine content, technologies and teaching approaches	Between Groups	1.114	2	.557	.859	.424
	Within Groups	410.983	634	.648		
	Total	412.097	636			
I possess adequate skills to provide leadership in helping others to coordinate the use of content, technologies and teaching approaches	Between Groups	9.260	2	4.630	6.747	.001*
	Within Groups	437.115	637	.686		
	Total	446.375	639			
I am able to use strategies that combine content, ICT, and teaching approaches	Between Groups	2.448	2	1.224	2.085	.125
	Within Groups	374.429	638	.587		
	Total	376.877	640			
I can appropriately combine content, ICT, and teaching approaches in a classroom lesson	Between Groups	5.963	2	2.982	2.613	.074
	Within Groups	724.584	635	1.141		
	Total	730.547	637			

* Significant: p <.05

Table A.6.8 - ANOVA - Pre-service teacher TPACK according to year of study

Technological Knowledge (TK)

		Sum of Squares	df	Mean Square	F	Sig.
I know how to solve my own technical problems	Between Groups	21.671	3	7.224	8.313	.000*
	Within Groups	550.062	633	.869		
	Total	571.733	636			
I learn technology easily	Between Groups	10.441	3	3.480	4.197	.006*
	Within Groups	524.125	632	.829		
	Total	534.566	635			
I keep up with new technologies	Between Groups	12.622	3	4.207	6.157	.000*
	Within Groups	431.183	631	.683		
	Total	443.805	634			
I frequently play	Between Groups	8.779	3	2.926	4.453	.004*

around with the technology	Within Groups	415.990	633	.657		
	Total	424.769	636			
I know a lot about different technologies	Between Groups	11.886	3	3.962	4.995	.002*
	Within Groups	498.923	629	.793		
	Total	510.809	632			
I have the technical skills needed to use technology	Between Groups	12.436	3	4.145	5.456	.001*
	Within Groups	478.701	630	.760		
	Total	491.137	633			

Technological Pedagogical Knowledge (TPK)

		Sum of Squares	df	Mean Square	F	Sig.
I know how to choose technologies that enhance students' learning for a lesson	Between Groups	6.985	3	2.328	4.127	.007*
	Within Groups	354.350	628	.564		
	Total	361.335	631			
I know how choose appropriate technologies to enhance teaching approaches for a lesson	Between Groups	31.298	3	10.433	15.566	.000*
	Within Groups	423.575	632	.670		
	Total	454.873	635			
I can think critically about how to use technology in the classroom	Between Groups	11.642	3	3.881	6.059	.000*
	Within Groups	404.163	631	.641		
	Total	415.805	634			
I am confident to customize the technology that I own to different teaching activities	Between Groups	19.164	3	6.388	9.739	.000*
	Within Groups	412.552	629	.656		
	Total	431.716	632			
I am able to select appropriate technologies to use in my classroom to enhance what I teach	Between Groups	16.145	3	5.382	8.855	.000*
	Within Groups	382.285	629	.608		
	Total	398.430	632			

Technological Content Knowledge (TCK)

		Sum of Squares	df	Mean Square	F	Sig.
I know how to choose appropriate technologies that enhance the development of GNH values in my lessons	Between Groups	5.506	3	1.835	2.651	.048*
	Within Groups	434.091	627	.692		
	Total	439.597	630			
I know how to choose technologies that can enhance the content for a lesson	Between Groups	14.762	3	4.921	8.909	.000*
	Within Groups	350.155	634	.552		
	Total	364.917	637			
I know how to select ICT that enhances what I teach	Between Groups	18.460	3	6.153	11.288	.000*
	Within Groups	343.950	631	.545		
	Total	362.409	634			

Technological Pedagogical Content Knowledge (TPACK)

		Sum of Squares	df	Mean Square	F	Sig.
I know how to use strategies that combine content, technologies and teaching approaches	Between Groups	39.006	3	13.002	22.010	.000*
	Within Groups	369.213	625	.591		
	Total	408.219	628			
I possess adequate skills to provide leadership in helping others to coordinate the use of content, technologies and teaching approaches	Between Groups	7.910	3	2.637	3.787	.010*
	Within Groups	437.203	628	.696		
	Total	445.112	631			
I am able to use strategies that combine content, ICT, and teaching approaches	Between Groups	16.215	3	5.405	9.488	.000*
	Within Groups	358.319	629	.570		
	Total	374.534	632			
I can appropriately combine content, ICT, and teaching approaches in a classroom lesson	Between Groups	20.608	3	6.869	6.120	.000*
	Within Groups	702.700	626	1.123		
	Total	723.308	629			

* Significant: $p < .05$

Appendix 7 - Lecturer web-based survey results

Table A.7.1 - Independent t-test - male and female lecturer perceptions of pre-service teachers

Item	t	df	sig.
GNH and GNH in Education			
I am confident my students possess adequate knowledge about GNH principles and values	1.39	24	0.18
I am confident my students believe GNH should be infused into my day-to-day teaching	1.25	24	0.23
I am confident my students believe it is necessary for the pre-service teacher curriculum in Bhutan to reflect GNH	1.59	24	0.13
ICT in Education			
I am confident my students believe ICT tools can make my teaching and learning more effective	-0.80	24	0.43
I am confident my students believe the use of ICT tools make learning activities more efficient	-1.27	24	0.22
I am confident my students believe ICT enhances the way they learn	-1.87	24	0.07
I am confident my students believe ICT is an effective tool to create conducive learning environments for learners	0.83	24	0.42
I am confident my students believe ICT is a good tool to engage students	0.14	24	0.89
I am confident my students believe ICT can make learning more efficient	0.99	24	0.33
I am confident my students believe ICT can improve the quality of education	1.39	24	0.18
I am confident my students believe ICT can improve the academic performance of learners	1.67	24	0.11
I am confident my students believe using ICT has the potential to improve one's ability to teach	0.46	24	0.65
I am confident my students believe it is possible to change learning from passive to active using ICT tools	0.29	24	0.78
ICT enhancing GNH principles and values			
I am confident my students believe ICT has the potential to make them more imaginative students	-1.91	24	0.07
I am confident my students believe ICT tools can help enhance creativity	0.96	24	0.35
I am confident my students believe ICT tools have the potential to effectively internalise GNH values	2.54	24	0.02*
I am confident my students believe ICT can be an effective tool to foster GNH to better become part of their lives	2.15	24	0.04*
I am confident my students believe ICT tools can make learning more enjoyable	-0.83	24	0.42
I am confident my students believe ICT tools can make learning more relevant	0.13	24	0.90
I am confident my students believe GNH values are enhanced more efficiently using ICT tools	1.66	24	0.11
I am confident my students believe ICT is an efficient tool to enhance GNH values such as integrity	0.83	24	0.41
I am confident my students believe ICT is an efficient tool to enhance their motivation to learn	1.06	24	0.30
I am confident my students believe the use of ICT tools aid in enhancing critical thinking skills	1.14	24	0.26
I am confident my students believe that using ICT tools enhance student ability to collaborate efficiently	1.13	24	0.27
I am confident my students believe ICT tools possess the potential to make learners become more reflective	2.23	24	0.04
I am confident my students believe ICT is a good tool to help one become more mindful about what one does	0.70	24	0.49
I am confident my students believe ICT is an effective tool to learn about media literacy	-0.29	24	0.77
I am confident my students believe ICT has the potential to create life-long learners	2.08	24	0.05*
I am confident my students believe using ICT tools can improve a student's emotional well-being	0.59	24	0.56
I am confident my students believe using ICT can empower a learner	2.02	24	0.06

* Significant: $p < .05$

Table A.7.2 - ANOVA - Lecturer perceptions of pre-service teachers according to age range

GNH and GNH in Education

		Sum of Squares	df	Mean Square	F	Sig.
I am confident my students possess adequate knowledge about GNH principles and values	Between Groups	5.246	4	1.312	1.219	.333
	Within Groups	22.600	21	1.076		
	Total	27.846	25			
I am confident my students believe GNH should be infused into my day-to-day teaching	Between Groups	4.696	4	1.174	1.575	.218
	Within Groups	15.650	21	.745		
	Total	20.346	25			
I am confident my students believe it is necessary for the pre-service teacher curriculum in Bhutan to reflect GNH	Between Groups	5.318	4	1.329	1.917	.145
	Within Groups	14.567	21	.694		
	Total	19.885	25			

ICT in Education

		Sum of Squares	df	Mean Square	F	Sig.
I am confident my students believe ICT tools can make my teaching and learning more effective	Between Groups	1.104	4	.276	1.092	.387
	Within Groups	5.056	20	.253		
	Total	6.160	24			
I am confident my students believe the use of ICT tools make learning activities more efficient	Between Groups	.927	4	.232	.885	.491
	Within Groups	5.233	20	.262		
	Total	6.160	24			
I am confident my students believe ICT enhances the way they learn	Between Groups	.849	4	.212	.773	.555
	Within Groups	5.767	21	.275		
	Total	6.615	25			
I am confident my students believe ICT is an effective tool to create conducive learning environments for learners	Between Groups	.265	4	.066	.167	.953
	Within Groups	8.350	21	.398		
	Total	8.615	25			

I am confident my students believe ICT is a good tool to engage students	Between Groups	.799	4	.200	.971	.444
	Within Groups	4.317	21	.206		
	Total	5.115	25			
I am confident my students believe ICT can make learning more efficient	Between Groups	2.877	4	.719	3.208	.035*
	Within Groups	4.483	20	.224		
	Total	7.360	24			
I am confident my students believe ICT can improve the quality of education	Between Groups	1.278	4	.320	1.181	.348
	Within Groups	5.683	21	.271		
	Total	6.962	25			
I am confident my students believe ICT can improve the academic performance of learners	Between Groups	.913	4	.228	.536	.711
	Within Groups	8.933	21	.425		
	Total	9.846	25			
I am confident my students believe using ICT has the potential to improve one's ability to teach	Between Groups	.946	4	.237	.720	.588
	Within Groups	6.900	21	.329		
	Total	7.846	25			
I am confident my students believe it is possible to change learning from passive to active using ICT tools	Between Groups	.562	4	.140	.670	.620
	Within Groups	4.400	21	.210		
	Total	4.962	25			

ICT enhancing GNH principles and values

		Sum of Squares	df	Mean Square	F	Sig.
I am confident my students believe ICT has the potential to make them more imaginative students	Between Groups	.562	4	.140	.205	.933
	Within Groups	14.400	21	.686		
	Total	14.962	25			
I am confident my students believe ICT tools can help enhance creativity	Between Groups	1.199	4	.300	.408	.801
	Within Groups	15.417	21	.734		
	Total	16.615	25			
I am confident my	Between Groups	1.163	4	.291	.402	.805

students believe ICT tools have the potential to effectively internalise GNH values	Within Groups	15.183	21	.723		
	Total	16.346	25			
I am confident my students believe ICT can be an effective tool to foster GNH to better become part of their lives	Between Groups	2.373	4	.593	.856	.507
	Within Groups	13.867	20	.693		
	Total	16.240	24			
I am confident my students believe ICT tools can make learning more enjoyable	Between Groups	.683	4	.171	.617	.655
	Within Groups	5.817	21	.277		
	Total	6.500	25			
I am confident my students believe ICT tools can make learning more relevant	Between Groups	.985	4	.246	.417	.795
	Within Groups	12.400	21	.590		
	Total	13.385	25			
I am confident my students believe GNH values are enhanced more efficiently using ICT tools	Between Groups	.458	4	.115	.189	.941
	Within Groups	11.500	19	.605		
	Total	11.958	23			
I am confident my students believe ICT is an efficient tool to enhance GNH values such as integrity	Between Groups	1.246	4	.312	.589	.674
	Within Groups	11.100	21	.529		
	Total	12.346	25			
I am confident my students believe ICT is an efficient tool to enhance their motivation to learn	Between Groups	1.360	4	.340	1.700	.190
	Within Groups	4.000	20	.200		
	Total	5.360	24			
I am confident my students believe the use of ICT tools aid in enhancing critical thinking skills	Between Groups	2.400	4	.600	1.086	.389
	Within Groups	11.600	21	.552		
	Total	14.000	25			
I am confident my students believe that using ICT tools enhance student ability to collaborate efficiently	Between Groups	1.100	4	.275	.426	.788
	Within Groups	12.900	20	.645		
	Total	14.000	24			
I am confident my	Between Groups	2.767	4	.692	1.498	.240

students believe ICT tools possess the potential to make learners become more reflective	Within Groups	9.233	20	.462		
	Total	12.000	24			
I am confident my students believe ICT is a good tool to help one become more mindful about what one does	Between Groups	2.104	4	.526	.583	.679
	Within Groups	18.056	20	.903		
	Total	20.160	24			
I am confident my students believe ICT is an effective tool to learn about media literacy	Between Groups	1.833	4	.458	1.486	.244
	Within Groups	6.167	20	.308		
	Total	8.000	24			
I am confident my students believe ICT has the potential to create life-long learners	Between Groups	1.862	4	.465	.880	.492
	Within Groups	11.100	21	.529		
	Total	12.962	25			
I am confident my students believe using ICT tools can improve a student's emotional well-being	Between Groups	.433	4	.108	.189	.942
	Within Groups	12.067	21	.575		
	Total	12.500	25			
I am confident my students believe using ICT can empower a learner	Between Groups	1.087	4	.272	.597	.669
	Within Groups	9.567	21	.456		
	Total	10.654	25			

* Significant: p <.05

Table A.7.3 - ANOVA - Lecturer perceptions of pre-service teachers according to teaching experience

GNH and GNH in Education

		Sum of Squares	df	Mean Square	F	Sig.
I am confident my students possess adequate knowledge about GNH principles and values	Between Groups	6.413	5	1.283	1.197	.346
	Within Groups	21.433	20	1.072		
	Total	27.846	25			
I am confident my students believe GNH should be infused into my day-to-day teaching	Between Groups	5.146	5	1.029	1.354	.283
	Within Groups	15.200	20	.760		
	Total	20.346	25			

I am confident my students believe it is necessary for the pre-service teacher curriculum in Bhutan to reflect GNH	Between Groups	5.151	5	1.030	1.399	.267
	Within Groups	14.733	20	.737		
	Total	19.885	25			

ICT in Education

		Sum of Squares	df	Mean Square	F	Sig.
I am confident my students believe ICT tools can make my teaching and learning more effective	Between Groups	1.260	5	.252	.977	.457
	Within Groups	4.900	19	.258		
	Total	6.160	24			
I am confident my students believe the use of ICT tools make learning activities more efficient	Between Groups	1.304	5	.261	1.021	.433
	Within Groups	4.856	19	.256		
	Total	6.160	24			
I am confident my students believe ICT enhances the way they learn	Between Groups	.382	5	.076	.245	.937
	Within Groups	6.233	20	.312		
	Total	6.615	25			
I am confident my students believe ICT is an effective tool to create conducive learning environments for learners	Between Groups	1.715	5	.343	.994	.446
	Within Groups	6.900	20	.345		
	Total	8.615	25			
I am confident my students believe ICT is a good tool to engage students	Between Groups	1.315	5	.263	1.385	.272
	Within Groups	3.800	20	.190		
	Total	5.115	25			
I am confident my students believe ICT can make learning more efficient	Between Groups	2.827	5	.565	2.369	.079
	Within Groups	4.533	19	.239		
	Total	7.360	24			
I am confident my students believe ICT can improve the quality of education	Between Groups	2.428	5	.486	2.143	.102
	Within Groups	4.533	20	.227		
	Total	6.962	25			
I am confident my students believe ICT can improve	Between Groups	1.713	5	.343	.842	.536
	Within Groups	8.133	20	.407		

the academic performance of learners	Total	9.846	25			
I am confident my students believe using ICT has the potential to improve one's ability to teach	Between Groups	.913	5	.183	.527	.753
	Within Groups	6.933	20	.347		
	Total	7.846	25			
I am confident my students believe it is possible to change learning from passive to active using ICT tools	Between Groups	1.262	5	.252	1.364	.279
	Within Groups	3.700	20	.185		
	Total	4.962	25			

ICT enhancing GNH principles and values

		Sum of Squares	df	Mean Square	F	Sig.
I am confident my students believe ICT has the potential to make them more imaginative students	Between Groups	.762	5	.152	.215	.952
	Within Groups	14.200	20	.710		
	Total	14.962	25			
I am confident my students believe ICT tools can help enhance creativity	Between Groups	.815	5	.163	.206	.956
	Within Groups	15.800	20	.790		
	Total	16.615	25			
I am confident my students believe ICT tools have the potential to effectively internalise GNH values	Between Groups	3.213	5	.643	.979	.455
	Within Groups	13.133	20	.657		
	Total	16.346	25			
I am confident my students believe ICT can be an effective tool to foster GNH to better become part of their lives	Between Groups	1.484	5	.297	.382	.855
	Within Groups	14.756	19	.777		
	Total	16.240	24			
I am confident my students believe ICT tools can make learning more enjoyable	Between Groups	.867	5	.173	.615	.689
	Within Groups	5.633	20	.282		
	Total	6.500	25			

I am confident my students believe ICT tools can make learning more relevant	Between Groups	2.251	5	.450	.809	.557
	Within Groups	11.133	20	.557		
	Total	13.385	25			
I am confident my students believe GNH values are enhanced more efficiently using ICT tools	Between Groups	1.058	5	.212	.350	.876
	Within Groups	10.900	18	.606		
	Total	11.958	23			
I am confident my students believe ICT is an efficient tool to enhance GNH values such as integrity	Between Groups	1.613	5	.323	.601	.700
	Within Groups	10.733	20	.537		
	Total	12.346	25			
I am confident my students believe ICT is an efficient tool to enhance their motivation to learn	Between Groups	.460	5	.092	.357	.872
	Within Groups	4.900	19	.258		
	Total	5.360	24			
I am confident my students believe the use of ICT tools aid in enhancing critical thinking skills	Between Groups	1.100	5	.220	.341	.882
	Within Groups	12.900	20	.645		
	Total	14.000	25			
I am confident my students believe that using ICT tools enhance student ability to collaborate efficiently	Between Groups	.611	5	.122	.173	.969
	Within Groups	13.389	19	.705		
	Total	14.000	24			
I am confident my students believe ICT tools possess the potential to make learners become more reflective	Between Groups	1.911	5	.382	.720	.617
	Within Groups	10.089	19	.531		
	Total	12.000	24			
I am confident my students believe ICT is a good tool to help one become more mindful about what one does	Between Groups	1.960	5	.392	.409	.836
	Within Groups	18.200	19	.958		
	Total	20.160	24			
I am confident my students believe ICT is an effective tool to learn about media literacy	Between Groups	3.400	5	.680	2.809	.046*
	Within Groups	4.600	19	.242		
	Total	8.000	24			

I am confident my students believe ICT has the potential to create life-long learners	Between Groups	2.328	5	.466	.876	.515
	Within Groups	10.633	20	.532		
	Total	12.962	25			
I am confident my students believe using ICT tools can improve a student's emotional well-being	Between Groups	.300	5	.060	.098	.991
	Within Groups	12.200	20	.610		
	Total	12.500	25			
I am confident my students believe using ICT can empower a learner	Between Groups	1.754	5	.351	.788	.570
	Within Groups	8.900	20	.445		
	Total	10.654	25			

* Significant: p <.05

Table A.7.4 - Independent t-test - male and female lecturer TPACK

Item	t	df	sig.
Technological Knowledge (TK)			
I know how to solve my own technical problems	0.33	24	0.74
I learn technology easily	0.00	24	1.00
I keep up with new technologies	-0.48	24	0.64
I frequently play around with the technology	0.75	24	0.46
I know a lot about different technologies	-0.25	24	0.81
I have the technical skills needed to use technology	1.32	24	0.20
Technological Pedagogical Knowledge (TPK)			
I know how to choose technologies that enhance student learning for a lesson	1.68	24	0.11
I know how choose appropriate technologies to enhance teaching approaches for a lesson	0.83	24	0.41
I think critically about how to use technology in the classroom	1.36	24	0.19
I am confident to customise the technology that I own to different teaching activities	2.03	24	0.05*
I am able to select appropriate technologies to use in my classroom to enhance what I teach	1.81	24	0.08
Technological Content Knowledge (TCK)			
I know how to choose appropriate technologies that enhance the development of GNH values in my lessons	1.07	24	0.29
I know how to choose technologies that can enhance the content for a lesson	0.90	24	0.38
I know how to select ICT that enhances what I teach	1.89	24	0.07
Technological Pedagogical Content Knowledge (TPACK)			
I know how to use strategies that combine content, technologies and teaching approaches	0.46	24	0.65
I possess adequate skills to provide leadership in helping others in the use of content, ICT and teaching approaches	1.37	24	0.19
I am able to use strategies that combine content, ICT, and teaching approaches	1.10	24	0.28
I can appropriately combine, content, technologies and teaching approaches in a classroom lesson	-1.21	24	0.24

* Significant: p <.05

Table A.7.5 - ANOVA - Lecturer TPACK according to age range

Technological Knowledge (TK)

		Sum of Squares	df	Mean Square	F	Sig.
I know how to solve my own technical problems	Between Groups	5.951	4	1.488	1.792	.168
	Within Groups	17.433	21	.830		
	Total	23.385	25			
I learn technology easily	Between Groups	4.333	4	1.083	1.665	.196
	Within Groups	13.667	21	.651		
	Total	18.000	25			
I keep up with new technologies	Between Groups	2.254	4	.563	.851	.509
	Within Groups	13.900	21	.662		
	Total	16.154	25			
I frequently play around with the technology	Between Groups	7.946	4	1.987	3.364	.028*
	Within Groups	12.400	21	.590		
	Total	20.346	25			
I know a lot about different technologies	Between Groups	2.013	4	.503	1.268	.314
	Within Groups	8.333	21	.397		
	Total	10.346	25			
I have the technical skills needed to use technology	Between Groups	9.487	4	2.372	3.783	.018*
	Within Groups	13.167	21	.627		
	Total	22.654	25			

Technological Pedagogical Knowledge (TPK)

		Sum of Squares	df	Mean Square	F	Sig.
I know how choose appropriate technologies to enhance teaching approaches for a lesson	Between Groups	4.195	4	1.049	1.544	.226
	Within Groups	14.267	21	.679		
	Total	18.462	25			

I think critically about how to use technology in the classroom	Between Groups	.650	4	.163	.442	.777
	Within Groups	7.350	20	.368		
	Total	8.000	24			
I am confident to customise the technology that I own to different teaching activities	Between Groups	4.254	4	1.064	1.487	.244
	Within Groups	14.306	20	.715		
	Total	18.560	24			
I am able to select appropriate technologies to use in my classroom to enhance what I teach	Between Groups	5.145	4	1.286	2.387	.084
	Within Groups	11.317	21	.539		
	Total	16.462	25			

Technological Content Knowledge (TCK)

		Sum of Squares	df	Mean Square	F	Sig.
I know how to choose appropriate technologies that enhance the development of GNH values in my lessons	Between Groups	.878	4	.220	.230	.919
	Within Groups	20.083	21	.956		
	Total	20.962	25			
I know how to choose technologies that can enhance the content for a lesson	Between Groups	4.823	4	1.206	1.798	.169
	Within Groups	13.417	20	.671		
	Total	18.240	24			
I know how to select ICT that enhances what I teach	Between Groups	2.278	4	.569	.972	.445
	Within Groups	11.722	20	.586		
	Total	14.000	24			

Technological Pedagogical Content Knowledge (TPACK)

		Sum of Squares	df	Mean Square	F	Sig.
I know how to use strategies that combine content, technologies and teaching approaches	Between Groups	4.758	4	1.190	1.520	.236
	Within Groups	14.867	19	.782		
	Total	19.625	23			
I possess adequate skills to provide leadership in	Between Groups	1.944	4	.486	.485	.747
	Within Groups	20.056	20	1.003		

helping others to coordinate the use of content, technologies and teaching approaches	Total	22.000	24			
I am able to use strategies that combine content, ICT, and teaching approaches	Between Groups	4.587	4	1.147	2.082	.119
	Within Groups	11.567	21	.551		
	Total	16.154	25			
I can appropriately combine, content, technologies and teaching approaches in a classroom lesson	Between Groups	3.183	4	.796	1.794	.168
	Within Groups	9.317	21	.444		
	Total	12.500	25			

Table A.7.6 - ANOVA - Lecturer TPACK according to teaching experience

Technological Knowledge (TK)

		Sum of Squares	df	Mean Square	F	Sig.
I know how to solve my own technical problems	Between Groups	3.985	5	.797	.822	.549
	Within Groups	19.400	20	.970		
	Total	23.385	25			
I learn technology easily	Between Groups	3.867	5	.773	1.094	.394
	Within Groups	14.133	20	.707		
	Total	18.000	25			
I keep up with new technologies	Between Groups	2.021	5	.404	.572	.721
	Within Groups	14.133	20	.707		
	Total	16.154	25			
I frequently play around with the technology	Between Groups	2.113	5	.423	.464	.799
	Within Groups	18.233	20	.912		
	Total	20.346	25			
I know a lot about different technologies	Between Groups	.746	5	.149	.311	.901
	Within Groups	9.600	20	.480		
	Total	10.346	25			

I have the technical skills needed to use technology	Between Groups	6.554	5	1.311	1.628	.198
	Within Groups	16.100	20	.805		
	Total	22.654	25			

Technological Pedagogical Knowledge (TPK)

		Sum of Squares	df	Mean Square	F	Sig.
I know how to choose technologies that enhance student learning for a lesson	Between Groups	2.862	5	.572	1.192	.348
	Within Groups	9.600	20	.480		
	Total	12.462	25			
I know how choose appropriate technologies to enhance teaching approaches for a lesson	Between Groups	1.362	5	.272	.318	.896
	Within Groups	17.100	20	.855		
	Total	18.462	25			
I think critically about how to use technology in the classroom	Between Groups	3.017	5	.603	2.300	.086
	Within Groups	4.983	19	.262		
	Total	8.000	24			
I am confident to customise the technology that I own to different teaching activities	Between Groups	5.260	5	1.052	1.503	.236
	Within Groups	13.300	19	.700		
	Total	18.560	24			
I am able to select appropriate technologies to use in my classroom to enhance what I teach	Between Groups	3.662	5	.732	1.144	.370
	Within Groups	12.800	20	.640		
	Total	16.462	25			

Technological Content Knowledge (TCK)

		Sum of Squares	df	Mean Square	F	Sig.
I know how to choose appropriate technologies that enhance the development of GNH values in my lessons	Between Groups	1.262	5	.252	.256	.932
	Within Groups	19.700	20	.985		
	Total	20.962	25			
I know how to choose technologies that can enhance the content for a lesson	Between Groups	4.240	5	.848	1.151	.369
	Within Groups	14.000	19	.737		
	Total	18.240	24			
I know how to select ICT that enhances what I teach	Between Groups	2.300	5	.460	.747	.598
	Within Groups	11.700	19	.616		
	Total	14.000	24			

Technological Pedagogical Content Knowledge (TPACK)

		Sum of Squares	df	Mean Square	F	Sig.
I know how to use strategies that combine content, technologies and teaching approaches	Between Groups	7.403	5	1.481	2.180	.102
	Within Groups	12.222	18	.679		
	Total	19.625	23			
I possess adequate skills to provide leadership in helping others to coordinate the use of content, technologies and teaching approaches	Between Groups	5.100	5	1.020	1.147	.371
	Within Groups	16.900	19	.889		
	Total	22.000	24			
I am able to use strategies that combine content, ICT, and teaching approaches	Between Groups	7.021	5	1.404	3.075	.032*
	Within Groups	9.133	20	.457		
	Total	16.154	25			

* Significant: $p < .05$

Table A.7.7 - Independent t-test - pre-service teacher and lecturer perceptions

Item	t	df	sig.
GNH and GNH in Education			
I believe I possess adequate knowledge about GNH principles and values	6.36	25.8	0.000*
I believe GNH should be infused into my day-to-day teaching	5.62	26.0	0.000*
I believe it is necessary for pre-service teacher curriculum in Bhutan to reflect GNH	5.21	25.9	0.000*
ICT in Education			
I believe ICT tools can make my teaching and learning more effective	0.42	688	0.676
I believe the use of ICT tools make activities more efficient	-0.28	691	0.778
I believe ICT enhances the way I learn	0.44	688	0.663
I believe ICT is an effective tool to create conducive learning environments for learners	3.12	691	0.002*
I believe ICT is a good tool to engage students	0.13	29.2	0.896
I believe ICT can make learning more efficient	0.52	680	0.601
I believe ICT can improve quality of education	1.62	686	0.106
I believe ICT can improve the academic performance of learners	0.86	27.7	0.396
I believe using ICT has the potential to improve one's ability to teach	1.12	689	0.263
I believe it possible to change learning from passive to active using ICT tools	0.42	680	0.674
ICT enhancing GNH principles and values			
I believe ICT has the potential to make me a more imaginative student	1.71	688	0.087
I believe ICT tools can help enhance creativity	-0.08	687	0.934
I believe ICT tools have the potential to effectively internalize GNH values	3.62	687	0.000*
I believe ICT can be an effective tool to foster GNH to better become part of our lives	3.50	689	0.001*
I believe ICT tools can make learning more enjoyable	-0.26	689	0.796
I believe ICT tools can make learning more relevant	0.75	688	0.455
I believe GNH values are enhanced more efficiently using ICT tools	2.03	687	0.042*
I believe ICT is an efficient tool to enhance GNH values such as integrity	3.23	687	0.001*
I believe ICT is an efficient tool to enhance my motivation to learn	0.32	686	0.748
I believe the use of ICT tools aid in enhancing my critical thinking skills	-0.22	685	0.830
I believe using ICT tools enhance my ability to collaborate efficiently	-0.06	681	0.953
I believe ICT tools possess the potential to make me become more reflective	1.51	687	0.133
I believe ICT is a good tool to help me become more mindful about what I do	2.69	683	0.007*
I believe ICT is an effective tool to learn about media literacy	1.71	687	0.087
I believe ICT has the potential to create life long learners	0.57	685	0.567
I believe using ICT tools can improve a learner's emotional well-being	1.69	690	0.091
I believe using ICT can empower a learner	0.19	687	0.848

* Significant: $p < .05$

Table A.7.8 - Independent t-test - pre-service teacher and lecturer TPACK

Item	t	df	sig.
Technological Knowledge (TK)			
I know how to solve my own technical problems	1.11	669	0.266
I learn technology easily	1.73	668	0.084
I keep up with new technologies	0.46	667	0.643
I frequently play around with the technology	1.10	669	0.273
I know a lot about different technologies	2.47	664	0.014*
I have the technical skills needed to use technology	0.45	666	0.654
Technological Pedagogical Knowledge (TPK)			
I know how to choose technologies that enhance students' learning for a lesson	1.06	664	0.291
I know how choose appropriate technologies to enhance teaching approaches for a lesson	0.14	668	0.892
I can think critically about how to use technology in the classroom	-0.38	666	0.704
I am confident to customize the technology that I own to different teaching activities	0.87	665	0.383
I am able to select appropriate technologies to use in my classroom to enhance what I teach	0.63	663	0.529
Technological Content Knowledge (TCK)			
I know how to choose technologies that enhance the development of GNH values in my lessons	1.86	663	0.064
I know how to choose technologies that can enhance the content for a lesson	0.89	669	0.374
I know how to select ICT that enhances what I teach	1.19	666	0.235
Technological Pedagogical Content Knowledge (TPACK)			
I know how to use strategies that combine content, technologies and teaching approaches	0.11	660	0.91
I possess adequate skills to provide leadership in helping others	2.01	663	0.045*
I am able to use strategies that combine content, ICT, and teaching approaches	0.93	26.9	0.792
I can appropriately combine content, ICT, and teaching approaches in a classroom lesson	-0.77	662	0.442

* Significant: $p < .05$