MONASH University

The influence of post-secondary students' technology use on their epistemological beliefs, conceptions of, and approaches to learning

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ABSTRACT

The rapid advances of Information and Communication Technology (henceforth referred to as ICT) has brought forth many new possibilities for education (Chai, Teo & Lee, 2009b; Deng, Chai, Tsai & Lee, 2014), thus, potentially changing the way we teach and learn (Fatt, 2003; Jimoyiannis & Komis, 2007; Littlejohn, Margaryan & Vojt, 2010). However, as postulated by Eristi, Kurt and Dindar (2012) as well as Yeung, Lim, Tay, Lam-Chiang and Hui (2012), the quality of education (including teaching and learning processes), can only be enhanced when technology is used appropriately under certain conditions.

Previous studies have revealed the influence that a student's beliefs about knowledge can have on the effectiveness of learning (Gurcay, Wong & Chai, 2013; Lim & Chai, 2008). Such studies claim that learners' epistemological beliefs are essential elements of student learning. Epistemological beliefs include beliefs about what constitutes knowledge, how knowledge is acquired and who constructs or discovers knowledge. Such beliefs may have an influence on views of learning and teaching, such as one's beliefs about how to approach learning and, thus, about what constitutes effective teaching (Brownlee, Walker, Lennox, Exley & Pearce, 2009; Cano, 2005; Chai, Wong & Teo, 2011; Liang, Lee & Tsai, 2010; Chai, Khine & Teo 2006; Tolhurst, 2007).

Given the way that technology can transform the way we access, consume, disseminate and create ideas and information, it seems plausible that technological advancements would transform students' epistemological beliefs and conceptions of learning. It is also possible that students' epistemological beliefs and conceptions of learning would shape their use of technology, especially within formal educational settings where there is a focus on acquiring or constructing knowledge (Aypay, 2010; Corte, Op't Eynde & Verschaffel, 2002; Demirbilek, 2014; Loyens, Remy & Schmidt, 2008; Ogan-Bekiroglu & Sengul-Turgut, 2008; Paulsen & Well, 1998; Dillon & Gabbard, 1998; Tsai & Chuang, 2005; Tu, Shih & Tsai, 2008; Zhu, Valcke & Schellens, 2008). Therefore, the relationship between students' use of technology, their epistemological beliefs and their

conceptions about learning are worthy of investigation. This investigation is particularly important given the proliferation of new technologies over the past two decades and the extent to which educational institutions, including higher education providers, have invested in such technologies (Hew & Brush, 2007; Yap, Tan, Zhu & Wettasinghe, 2008).

Using semi-structured interviews, this study examined the relationship between some Singaporean Polytechnic students' epistemological beliefs, conceptions of, and approaches to, learning and their use of technology. To this end, the research questions were:

(i) What is the extent and nature of Polytechnic students' technology use for learning purposes?

(ii) What are the epistemological beliefs surrounding learning with technologies among the post-secondary students, their conceptions of, and approaches to learning?

(iii) How does the students' use of technology influence their beliefs about knowledge, conceptions of, and approaches to learning?

This study was situated in a "polytechnic". This is an institution of higher education that offers post-secondary vocational courses (A Guide to Polytechnic Education, 2015).

Using a qualitative approach, this study was conducted with six first year students and six third year students, aged between 17 and 19, from the School of InfoComm Technology in a Singapore Polytechnic. The interview analysis indicated that: (a) the participants' level of technology fluency was not homogenous; (b) all the participants were frequently exposed to conventional teaching methods; (c) some common approaches to learning were utilised by both groups of students, specifically, all the participants were found to adopt conventional, non-constructivist approaches to learning at least some of the time; (d) despite being raised amid a wide variety of digital technologies, there were students from both cohorts who showed some preference for more traditional teaching methods, as opposed to technology-based learning environments; (e) some students reported only a limited, and rather superficial, use of technology by educators (for example, posting lectures and other materials online); and, (f) contrary to expectations, a tendency

for naïve epistemological beliefs did not necessarily appear to decrease as students progressed to senior years. Both naïve and more sophisticated epistemological beliefs were found amongst both first year and third year students. Findings suggested that the evolution of technologies played a noteworthy role in the student's social life or leisure time, but there was no clear evidence that technologies had significantly transformed the students' beliefs about knowledge and learning or their approaches to learning within a formal education setting.

Although the research is limited by the small sample size, it is significant in that the results uncovered deeper insights into the nature of students' use of technology, the different aspects of students' notions of knowledge and learning and the interplay amongst these variables within the context of a Singaporean Polytechnic. This study also contributes to the knowledge base surrounding learning in a technology-based environment by detailing the IT skill levels, epistemological beliefs, learning conceptions and learning approaches of the twelve participants, and the possible relationship between these constructs.

The results of this study have several possible pedagogical and policy implications for future practice. In general, more work may need to be done to promote teaching and learning that utilises constructivist-oriented pedagogies to foster critical thinking amongst Singaporean Polytechnic students, especially in relation to learning with technology.

DECLARATION

This thesis contains no material which has been accepted for the award of any other degree or diploma at any university or equivalent institution and that, to the best of my knowledge and belief, this thesis contains no material previously published or written by another person, except where due reference is made in the text of the thesis.

Full Name Bee Peng TOH

Signed

Date 2 October 2015

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CHAPTER 1 INTRODUCTION

Information and Communication Technologies (ICT) not only opens up a diversity of new opportunities for rich and engaging learning experiences (Albion, Loch, Mula & Maroulis, 2010; Kennedy et al., 2008), but it also has the potential to transform how one thinks, communicates and feels (Demirbilek, 2014). "ICT" refers to a collection of digital tools used for communicating or accessing information, such as smart phones, computers, notebooks, other mobile devices and the internet (Prensky, 2001).

Today, schools are no longer the dominant source of knowledge and information (Cannata, 2009). With the emergence of new technologies, students need not merely consume information; they may easily collaborate and create new knowledge through digital technologies at anytime and anywhere (Fatt, 2003; Jimoyiannis & Komis, 2007). This change not only means that learning has become more flexible (Wang & Reeves, 2007; Trinidad & Broadley, 2008), providing students with more control over their own learning (Fatt, 2003; Chang & Smith, 2008), it also has the potential to promote constructivist learning experiences which may encourage students' critical thinking and collaboration in class (Tsai, 2004b). For instance, the roles of educator and student could change dramatically - from an "instructional paradigm", in which teachers deliver the instruction and students passively obtain information in the classroom, to a "learning paradigm", where students may be more actively involved in the learning process and teachers can act as facilitators (Georgescu, 2008; Mascolo, 2009).

Not only does the emergence of new technologies suggests potential changes to the way we teach and learn, it also influences almost every aspect of students' lives - their everyday beliefs about, and their use of, technologies (Kennedy & Fox, 2013; Waycott, Bennett, Kennedy, Dalgarno & Gray, 2010; Tapscott, 2009). Having been surrounded by and spent most of their lives with technologies, it is widely assumed that students today have a disposition for, and greater aptitude in using various technologies (Brown & Czerniewicz, 2010; Jones, Ramanau, Cross & Healing, 2010;

Kennedy, Judd, Churchward, Gray & Krause, 2010a; Kennedy, Judd, Dalgarnot & Waycott, 2010b; Oblinger & Oblinger, 2005). As such, they are frequently referred to as the 'Net Generation' or 'Digital Natives' (Beyers, 2009, p. 220; Prensky, 2001). It is also believed that the Net Generation expects technology to be an essential part of their lives (Waycott & Kennedy, 2009). For instance, different technologies, such as instant messaging, chat, video conversation, application sharing, blogs and podcasting, are often used to facilitate learning and communication between teachers and students, as well as between friends and family members (Daher, 2014; Lim, Zhao, Tondeur, Chai & Tsai, 2013; Oliver & Goerke, 2007). In other words, there has been a change in their day-to-day communications, both for academic and social purposes.

In summary, ICT may (i) provide opportunities to promote higher forms of thinking in educational settings; (ii) facilitate student-centred and independent learning; (iii) improve the interaction between teachers and students, as well as amongst students; and (iv) change the way we learn and acquire knowledge (Chai, Hong & Teo, 2009a; Gurcay et al., 2013; Fu, 2013; Lim & Hang, 2003; Wang, 2008).

Given the pervasiveness of technology into every aspect of our lives and the increasing evidence that technologies help to develop students' critical thinking, social, digital literacy and communication skills (Magolda & Terenzini, 1999; Gasser, 2011; Jimoyiannis & Komis, 2007; Jacobson et al., 2010; Lambert & Cuper, 2008; Luterbach & Brown, 2011; Snap & Fox-Turnbull, 2011), governments in many countries have devised policies to prepare and equip the younger generation with ICT knowledge and skills believed to be essential for navigating the "uncertain globalised world" (The Straits Times, 2011). The worldwide financial investment in technology in schools has multiplied by more than a hundred in the last twenty years (Lim et al., 2013). For example, in Singapore, the Ministry of Education has launched three Masterplans for IT in education (Hew & Brush, 2007; Jacobson et al., 2010; Ministry of Education, Singapore, 2008a) and invested a significant amount in educational technology (Yap et al., 2008). In the United

States, the government has reportedly invested $7.87 billion in the educational sector to improve and transform the learning environment in response to new technology (Hew & Brush, 2007). This growth in e-learning continues rapidly in educational institutions across the world (Fatt, 2003; Hew & Brush, 2007; Hew, 2009; Wong, Hew, & Cheung, 2009).

1.1 ICT in education in Singapore

The Singapore Masterplans for IT have been adopted by all schools, from primary and secondary schools to institutes of higher learning, such as polytechnics and universities with the purpose of developing IT competencies in students (Fatt, 2003). Recognizing the value of ICT in teaching and learning, a significant amount of resources has been invested to help schools improve their hardware and software and to train and equip teachers with IT competency so that they can incorporate technology effectively into their lessons (Ministry of Education, Singapore, 2008b; Educational Technology Division, Ministry of Education, Singapore, 2010). This is evident from the proliferation of educational initiatives relating to technology.

Prominent among these initiatives is the infrastructure upgrade plan by the National University of Singapore and Nanyang Technological University to create faster access to learning materials, along with the integration of technologies into the curriculum with the aim of improving instruction and facilitating discussions between students and tutors (Fatt, 2003; Wong et al., 2009). Other earlier initiatives include the use of audio podcasts (Hew, 2009); the introduction of Geographical Information Systems (Yap et al., 2008); and the use of Wireless Application Protocol technology for online discussions (Lee, 2004). Such initiatives are aligned with the Singapore Masterplans for IT in Education (Fatt, 2003).

The Singapore Masterplan for IT in education is a "blueprint" for incorporating technologies into teaching and learning. It was first launched by the Ministry of Education (MOE) in 1997 with the objective of providing basic IT infrastructure and developing teachers' IT competencies. The

second and third Masterplans, which were unveiled in 2002 and 2009, continued to strengthen the integration of technology in education and strive for the pervasive use of IT to bring about effective and innovative teaching and learning in schools (Info-communications Development Authority of Singapore, 2008; Ministry of Education, Singapore, 2008b).

These Singaporean educational policies and initiatives are based on the belief that harnessing technologies in education through appropriate pedagogical approaches will foster deep learning and autonomy (Fatt, 2003), develop students' higher-order thinking and problem solving skills (Yap et al., 2008), and promote flexible and collaborative learning (Yap et al., 2008; Hew, 2009).

In conjunction with the MOE's initiative to foster collaborative and independent learning among students, the Polytechnic in Singapore that is the locus of this study has undergone a major overhaul so as to emphasise the use of technology in the curriculum. To support the re-design of the Polytechnic's curriculum, the Polytechnic invested largely in an upgrade of the campus infrastructure. For example, in the 1990s, several initiatives, such as mobile e-Learning - an e-learning platform and a wireless campus network - were launched to improve the quality of learning experiences in the Polytechnic. Through these initiatives, students of the Polytechnic are no longer restricted by the conventional constraints of "time and space" (Hew, 2009, p. 334). They can access course materials and communicate with their tutors anytime and anywhere (Fatt, 2003; Lee, 2004; Hew, 2009). This potentially increases students' capacity for autonomy and self-regulated learning, proliferates opportunities for student-student and student-teacher interaction, as well as providing a means to create cooperative learning environments.

1.2 Need for the study

Despite this considerable investment in educational technologies, it is essential to explore whether digital learning environments really do meet the learning needs of students and transform

their views of teaching in positive ways. It has been argued that digital technology may not necessarily foster improved pedagogical practices, higher order thinking, deep learning or more sophisticated epistemological beliefs. Some have even raised concerns that such technologies may act as a distraction or inhibitor of such learning, teaching, and thinking (for example, Bleazby, 2012; Burbules & Callister, 1996; Carr, 2008; Cheong & Cheung, 2008; Cuban, 1993; Dreyfus, 2002; Friesen, 2009; Selwyn, 2013). Carr (2008) is even more critical, arguing that:

> The internet stresses immediacy, simultaneity, contingency, subjectivity, disposability, and, above all, speed. The Net provides no incentive to stop and think deeply about anything, to construct in our memory that 'dense depository' of knowledge'…. the common term "surfing the web" perfectly captures the essential superficiality of our relationship with the information we find. (p. 227-228)

It may also be the case that only particular educational uses of ICT, such as a constructivist-oriented use of ICT, can foster sophisticated epistemological beliefs and advanced learning conceptions. It has been suggested these are essential for students to succeed in this rapidly changing, complex and globalised environment (Gerjets & Hesse, 2004; Tsai, 1999).

For these reasons it is important to examine the use of ICT within educational settings and the relationship between student use of ICT, their beliefs about knowledge and their beliefs about, and approaches to learning. This may provide some insight into the extent to which ICT is being used in educational ways. Previous studies have shown that technology could influence how one thinks, acts and learns. In other words, one's interactions and experiences with ICT have resulted in specific learning preferences and styles. For example, the new generation of learners prefer "using a keyboard than writing on a stationary notebook, and feel more comfortable reading from a computer screen than from a traditional textbook" (Demirbilek, 2014, p. 115). Therefore, it is reasonable to expect that individual's epistemological beliefs, conceptions of, and approaches to learning may have been affected by their digitally mediated experiences and the digitally mediated

environment. However, it also seems plausible that their epistemological beliefs and conceptions of learning may influence their use of ICT, limiting or fostering the extent to which it is used in educational, intelligent ways.

1.3 Objectives of the study

As suggested earlier, media technology might influence how one thinks, acts and learns (Demirbilek, 2014). In this context, it is essential to understand not just students' beliefs about knowledge, how they view learning and acquire knowledge with ICT, but it is also imperative to understand their IT experiences in the digitally mediated environment. To this end, it is important to explore the relationship among the Polytechnic students' use of technology, their beliefs about, and approaches to learning.

The research questions of this study examine two interrelated issues, which are key to understanding the relationship between technology use and learning in higher education. The first issue concerns the nature of students' use of technology, their epistemological beliefs, conceptions of, and approaches to learning.

1. What is the extent and nature of Polytechnic students' technology use for learning purposes?
2. What are the epistemological beliefs surrounding learning with technologies among the post-secondary students, their conceptions of, and approaches to learning?

The second issue concerns the possible relationship between the students' use of technology, their beliefs about, and approaches to, learning.

3. How does the students' use of technology influence their beliefs about knowledge, conceptions of, and approaches to, learning?

1.4 Significance of the study

This study attempts to investigate how Singaporean Polytechnic students' use of technology is related to their epistemological beliefs, conceptions of, and approaches to learning. As such, the results of this research may provide invaluable insights for various groups of people, namely instructional designers, teacher educators, educational researchers and educational policy makers.

Students differ in the way they conceptualise learning and the way they learn. This study provides an insight into the beliefs that the participants hold that inform their views about learning and use of technology, which may provide educators, instructional designers and higher education providers with valuable insights into how individual students learns, and their expectations of learning at the tertiary level. If lecturers and instructional (learning) designers have a more refined understanding of the participants' use of ICT and their learning beliefs and preferences, they may be able to design and provide a more favourable learning environment for Polytechnic students, thus, enhancing and encouraging deep-level understandings of knowledge and more sophisticated learning approaches, especially in relation to the use of ICT. Additionally, the results of this study also provide some groundwork for further understanding the relationships, thus contributing to the existing body of knowledge about the factors contributing to school based curriculum development, especially in the local Singaporean educational context.

1.5 Organization of the thesis

Chapter Two presents a critical review of the literature on Net Generation learners, their epistemological beliefs, conceptions of, and approaches to learning. In addition, the chapter discusses the factors impacting these three constructs, as well as the relationships amongst students' use of technology, their epistemological beliefs, learning conceptions, and approaches to learning.

Chapter Three introduces the research paradigm and presents the conceptual framework. This chapter also explains the research design, which includes research aims, research methods, as

well as details about the sampling of participants, the recruitment strategies and ethical considerations of the study. In this chapter, data collection and analysis methods employed in this study are also discussed. Finally, Chapter Three also presents factors impacting the study design.

Chapter Four provides details of the sampled participants, focusing on their technological skills, the technology-based social activities they were engaged in, their prior learning experiences, their learning preferences, as well as their experiences of using technologies in the classroom and the teaching approaches to which they had been exposed. Thus, Chapter Four provides an in-depth understanding of the background information of the participants and this provides a framework to help understand the discussion of the interview data in the remaining chapters.

Chapter Five presents the results of this study. The data are presented thematically. First, the epistemological beliefs embraced by both groups of participants are discussed, followed by their learning conceptions and learning approaches. In this chapter, the two groups of participants (that is, first year and third year students) will be compared based on the identified key themes. This chapter also explores the possible factors that may have an effect on the participants' epistemological beliefs, their learning conceptions, and approaches to learning.

Chapter Six presents a more succinct description of each of the research questions. The conclusion, Chapter Seven, outlines the possible implications of the study, the potential future use of the findings and the limitations of the study, as well as areas for further research.

CHAPTER 2 LITERATURE REVIEW

It has been previously suggested that ICT may (i) provide the opportunities to promote higher forms of thinking in learning (Chai et al., 2009a); (ii) improve interaction between teachers and students as well as amongst students (Gurcay, Wong & Chai, 2013; Lim & Hang, 2003); (iii) facilitate student-centred and independent learning (Wang, 2008), and (iv) allow for the more efficient acquisition of knowledge, if it is used effectively (Fu, 2013). In this section, I set out to examine the different elements crucial to successful learning, especially in the digital age. This will include an examination of literature and empirical research about learners' beliefs about knowledge and learning and their approaches to learning.

These elements will be explored sequentially in the following sub-sections. First, learners in terms of their skills, use of technologies and preferences towards technologies will be reviewed. This is subsequently followed by learners' beliefs about knowledge, which is, arguably, one of the most fundamental determinants of learning. Epistemological beliefs underpin one's beliefs about what learning involves and, in turn, shape how one approaches learning. Thus, the discussion of epistemological beliefs will be followed by and connected to a discussion of the literature on students' beliefs about, and approaches to learning. I will also analyse the possible interrelationships among the Polytechnic students' use of technology, their beliefs about, and approaches to learning.

2.1 Learners, learning and literacy in the digital age

In today's digital age, technologies and technology tools, particularly Web 2.0 and mobile technologies, have had a significant influence on our everyday life (Littlejohn et al., 2010). For example, learning can now happen virtually (Chen, 2000; Upcraft & Terenzini, 1999), that is, students can learn and access education programs without "setting foot on campus" (Upcraft & Terenzini, 1999, p. 31) and "regardless of geographic location, physical limitation or personal

schedule" (Chen, 2000, p. 16). In the next few sub-sections, I will examine today's learners and how technologies are reshaping learning in schools.

2.1.1 Net Generation learners

The terms "Digital Natives" and "Net Generation" refer to the current generation of students who are born "between 1980 – 1994" (Beyers, 2009, p. 220; Prensky, 2001) and who have been exposed to a range of digital technologies from a young age (Brown & Czerniewicz, 2010). Having been immersed in a world of new technologies, current generations of students are said to have a "natural affinity" with digital technologies (Waycott et al., 2010, p. 1202; Kennedy et al., 2008). They are seemingly more tech savvy than previous generations (Brown & Czerniewicz, 2010; Lambert & Cuper, 2008). Although the notions of such students as digital natives have been uncritically accepted by some authors (Margaryan, Littlejohn & Vojt, 2011), there has also been debate about the assumptions inherent in such terms (Gros, Garcia & Escofet, 2012). It was argued that there is much variation within this new generation and between generations (Smith, 2012). In this section, I will look at how these students are thought to differ from earlier generations, in terms of their skills and experiences with technologies, as well as their preferences for the use of technologies as learning tools.

(a) Attributes of today's learners

It is frequently argued that Net Generation learners like to collaborate and share information (Nicholas & Regina, 2008; Tapscott, 2009). From 2010 to 2013, the use of social networking sites (for example Facebook, Twitter and Myspace) has increased fivefold from 5 percent to 25 percent of the population and it is expected to continue growing in the coming years (Blissenden, 2015). Studies have shown that a majority (more than 80 percent) of students used social networking sites for social and entertainment purposes (Catelly, 2015; Felea & Stanca, 2015) and about 68 percent of

the respondents used Web 2.0 applications for learning purposes (Logofatu & Visan, 2015). As defined by Efe (2015), Web 2.0 is the "second generation of Internet based devices on the World Wide Web" (p. 142), namely blogs, wikis, google drive, instant messaging, podcasts, social networks (e.g., Facebook) and content hosting sites. This could explain why the internet, messaging, emails, chat rooms and mobile phones have become an important part of students' lives (Prensky, 2001; Williams & Chinn, 2009). In another study conducted by Hamat, Embi and Hassan (2012), they found that undergraduate students also viewed social networking sites as an important part of their lives.

Due to their societal nature (Bullen & Morgan, 2011), the Net Generation are thought to be more critically aware of their socio-cultural environment. While these students are believed to use technologies extensively to search for world news, research has suggested they are "skeptical" (Tapscott, 2009, p. 80) about what they find and see on the web. They check sources by making comparisons between different sources, finding more information online, reading reviews, forums and blogs posted by the public and even consulting their friends. This is supported by research that shows that students are able to differentiate between facts and works of fiction, despite the large quantity of information available on the internet (Tapscott, 2009). However, this conflicts with other studies, which suggest that the Net Generation may be limited in their ability to use technologies responsibly, critically and ethically in virtual spaces (Luterbach & Brown, 2011).

The Net Generation's proficiency in using a wide range of digital technologies is also said to have influenced their preferences, skills and behaviours, especially in ways related to education (Bennett & Maton, 2010; Kennedy et al., 2007). For instance, it has been argued that they appear to be "inventive and self-sufficient problem solvers" (Kubiatko, 2013, p. 1264); prefer multiple and non-linear access to information (Kennedy et al., 2007; McLoughlin & Lee, 2008); favour games over lectures; and enjoy active learning and "interactive environments" (Williams & Chinn, 2009, p. 166; Greenhow, Robelia & Hughes, 2009; Lambert & Cuper, 2008). In addition, current

generations of students are claimed to have unique expectations about how they learn (Littlejohn et al., 2010). For example, they desire to have more "freedom of choice" (Tapscott, 2009, p. 6). By freedom, it is meant that they want to have the autonomy to choose where they want to work, who they want to be, what kind of education they want and even where, when and how they learn (Beyers, 2009; Tapscott, 2009). This may mean that the Net Generation value "self-discovery and self-realization" (Tapscott, 2009, p. 75; Nicholas & Regina, 2008). Thus, the pervasiveness of digital technology, such as the internet, has made it easy for students to search for information, explore different things and find a variety of options online and it is thought that this makes the Net Generation more informed and confident in their decision making and has increased their expectation for autonomy in regards to their own learning.

This generation, who have been raised in a fast-paced environment, are also said to expect immediate results (Bullen & Morgan, 2011; Littlejohn et al., 2010; Kennedy & Fox, 2013). Due to their "twitch-speed" nature (Prensky, 2001, p. 5), communication technologies, such as instant messaging and social networking sites, are often preferred by these students (Greenhow et al., 2009; Kennedy et al., 2007; Williams & Chinn, 2009). As the new generation of learners require rapid access to information, they are seen as youngsters who are impatient and dislike being controlled by authorities (Kubiatko, 2013). This could explain why students have lesser tolerance for lectures or short attention spans for teacher-directed approaches (Kennedy et al., 2007; Waycott et al., 2010). While they may not like to be controlled by authorities, they are said to appreciate feedback and want support from their teachers and parents (Kubiatko, 2013; Sandeen, 2008). It is also claimed that this impatience and increased expectation for autonomy is reflected in many aspects of their lives. For example, the Net Generation is also said to expect "rapid advancement and perks" in their careers and to be "career oriented" (p. 18) and accustomed to being in the limelight (Sandeen, 2008).

It has been argued that current generations of learners become listless easily and, for that reason, they expect their work to be fun and satisfying (Tapscott, 2009). To them, work and play are seen as equivalent entities. Therefore, taking time off from work to play online games or check Facebook is seen as fine as these are considered ways to relieve work pressure. This is consistent with Bullen and Morgan's (2011) study where a student reported using Facebook during her lessons to keep her awake and help her pay attention in class. As such, it is argued that educators should increase, and vary their use of, new technologies in the classroom so as to engage these students (Bracy, Bevill & Roach, 2010; Gorra et al., 2010).

As learners today may socialize, think and process information differently from earlier generations, who are referred to as "digital immigrants" (Prensky, 2001, p. 2; Beard & Dale, 2008), Kubiatko (2013) posits that the current teaching environment is not ready for these learners. To better prepare students with the necessary skills and knowledge to succeed in work, school and life, Snape and Fox-Turnbull (2011) advocate that the school environment needs to be transformed to allow for more "robust, broad, skilled and flexible" (p. 152) learning.

(b) Access to, and use of technologies

It is frequently assumed that the Net Generation is a homogenous group (at least in relation to their exposure to, and use of technologies) who possess advanced skills in using a variety of technologies (Kennedy et al., 2010b). They are often described as having "technology fluency" (Kvavik & Caruso, 2005, p. 44). However, empirical research does not necessarily support this assumption, with studies showing that current generations may be proficient with some technology, especially more common, less complex technology but not necessarily frequent or skilled users of specialised, sophisticated technology (Caruso & Kvavik, 2005; Margaryan & Littlejohn, 2008; Margaryan et al., 2011).

Thus, while the Net Generation have grown up in a digital era which has seen a rapid proliferation of new technologies (Kennedy et al., 2007) and many members of this generation possess a deep affinity with technologies (Waycott et al., 2010), the range of digital tools used by students were actually limited (Lai & Hong, 2015). For example, over 50 percent of the undergraduate students reported using laptop computer, mobile phone, MP3/iPod, internet browsers, Google and Facebook/MySpace on a daily basis for both social and work related activities. These students also reported not using digital tools like podcasts, simulation games, virtual games, blogging, Twitter, message boards, real-time chat video-conferencing, tablet computer and Google Scholar at all for both work and non-work related activities (Lai & Hong, 2015). This is not an unusual pattern as a 2007 survey conducted by Kennedy et al. to study how students' use technologies and technology-based tools in their daily lives and in school, also found that majority of students were frequent users of "established technologies" such as "computers, the internet, email, and mobile phones" (Waycott et al., 2010, p. 1203). For example, they used mobile phones more than once per day to make calls or send messages and used the internet numerous times per week for email and searching purposes. Such patterns of technology use could be attributed to a relatively high percentage of students owning mobile devices and computers. In a study conducted by Ber, Lombardo and Wimmer (2015), every student (a total of 188 undergraduate students in 2012 fall survey and 2013 fall survey) owned a laptop computer and almost 80 percent of the students owned a smartphone. This is similar to those found in earlier study (Salaway, Caruso, Nelson & Ellison, 2008), where about 66 percent, 80 percent and 54 percent of the students were found to possess mobile phones, laptops and desktop computers respectively. Amongst these respondents, about 36 percent of them were found to own both a laptop and a computer.

Although many students had infinite access to such established technologies, only a minority of them used emerging and new technologies (Jones et al., 2010; Margaryan et al., 2011),

suggesting that their technology use is far from advanced. This could be due to students having a greater preference for established technologies than contemporary technologies (Bennett & Maton, 2010). As defined by Kennedy et al. (2008), "advanced technology use" (p. 486) refers to the use of the latest web-based technologies, such as wikis, social bookmarking and podcasts, while contemporary technologies refer to things like "social bookmarking, contributing to wikis, and publishing and uploading podcasts" (p. 486).

Studies reveal a change in students' patterns of access to technology because of technological developments (Bennett & Maton, 2010; Gorra et al., 2010; Kennedy et al., 2008). For instance, some technologies, such as broadband connections, have become more popular among students in higher education, while others, like dial-up internet connection, have become less popular (Gorra et al., 2010; Bennett & Maton, 2010). The same studies also showed that there was a high ownership of portable devices (like mobile phones and MP3 players) and an increase in the ownership of notebooks or personal computers. This implies that as a new technology is available, people will adjust and use that technology (Demirbilek, 2014).

However, other research shows that the availability of some new technology in itself does not lead to students using it. There are other factors that influence their decisions about technology. Technology choices made by the Net Generation also appear to reflect "highly contextualized purposes" (Bennett & Maton, 2010, p. 324). That is, students are "discerning users of new technologies, wanting to see clear educational or social value in using technologies", rather than incorporating technologies in the classroom for technology's sake (Waycott et al., 2010, p. 1203). For example, some research has shown that the uptake of other widely available technology tools, such as handheld computers and personal digital assistants is limited (Bennett & Maton, 2010). The selection of technology for social and academic uses could be due to cost, ease of use, convenience, as well as the distinct advantage of the device over the existing technology that the students own (Bullen & Morgan, 2011; Bennett & Maton, 2010). For example, Jones and Healing (2010) argue

that "students' choices are not direct responses to technologies that are universally available" (p. 351), rather their choices are more likely to be responses to the specific requirements of their programs of study. Bennett and Maton (2010) have also explained that youths today are more sensitive to cost. Therefore, they would choose cheaper options like using text messaging instead of making telephone calls to their family and friends. These findings not only give us better insights into the devices higher education students use at home and school, but they also shed light on why they prefer and often use mobile phones rather than landlines to make phone calls and often prefer to use text messages for communication (Gorra et al., 2010).

(c) Skill levels with respect to digital technologies

Given differences in their use of technologies, it is not surprising that there is considerable diversity amongst the Net Generation in terms of their skill levels and confidence using technologies. A study by Jones and Healing (2010) showed that more than 80 percent of the students described themselves as moderate to highly skilled in using core technologies, which included presentation programs, online resources (like a learning management system and library websites), and text messaging. These core technologies could frequently be required in class. Therefore, students have more opportunities to use them (Kvavik & Caruso, 2005). In other words, it seems that the more often technologies are used, the more proficient the students become. Additionally, the student's educational level is also found to be another determining factor that may affect one's skill levels. For instance, it was reported that senior students tend to rate their skills higher than freshmen, in the areas of word processing, presentation software and online library resources. This suggests that training and the length of time the students use the software contribute to improving their technology skills (Kvavik & Caruso, 2005).

However, studies suggest students may be less confident with more sophisticated technologies. For example, Jones et al. (2010) postulated that over 30 percent of students reported

having minimal skills in the use of "advanced technologies", such as "virtual worlds and personal web publishing" (p. 724), and slightly over 40 percent and 60 percent reported having minimal skills in the use of graphics applications and audio/video editing applications respectively. These applications are referred to as "specialised applications" (Kvavik & Caruso, 2005, p. 48). This is in accord with a study conducted by Kennedy et al. (2007), which showed that the use of sophisticated media was uncommon amongst the students. Varying skill levels with such technology could be reflective of the students' major areas of studies with only students in ICT focused courses having much opportunity to use and develop proficiency with more sophisticated technology. That is, a student's area of study may provide limited opportunities to use such programs (Kennedy & Fox, 2013).

The evidence from Kvavik and Caruso's (2005) study is similar, with students reporting that they were more comfortable with "established technologies", such as "computers, the internet, email, and mobile phones" (Waycott et al., 2010, p. 1203), as opposed to Web 2.0 technologies. Kennedy et al. (2008) also reported that many students were uncertain what Web 2.0 tools were and that their mobile use was basic. Consequently, some researchers have concluded that, contrary to common assumptions, the technology-based skills of the Net Generation learners are "unspectacular" (Kennedy & Fox, 2013, p. 65; Brown & Czerniewicz, 2010; Jones & Healing, 2010). These findings contrast the assumption that Net Generation learners are "big users" of varied Web 2.0 technologies (Waycott et al., 2010, p.1205; Gorra et al., 2010), and have high levels of technological literacy (Oblinger & Oblinger, 2005). Research has also suggested that students who believed that they had better technology skills tended to indicate a greater preference for technology-based learning approaches, than those with basic technology skills (Littlejohn et al., 2010).

(d) Using technologies for play and study

While current students are frequent users of email, online chat and the internet, this has not necessarily resulted in greater preferences for technology in the classroom (Brown & Czerniewicz, 2010; Kvavik & Caruso, 2005). Instead, many students seem to prefer traditional teaching methods and more contact time with lecturers (Gorra et al., 2010). This is further supported by Kvavik and Caruso (2005), which reported that many of the students preferred face-to-face classroom experiences. For instance, 84 percent of the students preferred conventional teaching, 40 percent preferred taking courses that use technology moderately and 29 percent preferred limited use of technology or none at all in their programs. Only 30 percent of the students preferred extensive use of technology in the classroom. Such findings could be attributed to their desire for instantaneity, where they felt a lack of immediate response time in their online courses and from their lecturers (Bullen & Morgan, 2011). Additionally, it could also be attributed to other factors, such as teachers' pedagogical beliefs and their perceptions about the use of technologies (Chai et al., 2011; Gurcay et al., 2013); students' previous learning experiences, for instance, limited use of educational technologies in the classroom in the past (Kennedy & Fox, 2013; Waycott et al., 2010; Wu & Beckett, 2011); students' major, for example, students taking engineering appear to have higher preference for technology than students from the humanities; as well as students' perceptions of technology use in learning. That is, many students seem to regard technologies as merely tools for communicating and accessing existing information in a convenient manner (Kvavik & Caruso, 2005; Oliver & Goerke, 2007).

Although some studies revealed that students were not looking for extensive use of technologies in their programs (Benzing & Christ, 1997; Bracy et al., 2010; Kennedy et al., 2010a, 2010b), there are some technology-based activities that the students frequently use to support their studies. For example, technologies are often used to communicate with peers and teachers, access the school's learning management system and course materials, prepare presentations, and

collaborate with students. In the context of everyday or personal activities, the students describe using technologies mainly for social activities, like playing games, watching videos, mingling with friends and staying in touch with family (Bennett & Maton, 2010; Brown & Czerniewicz, 2010).

As for the use of Web 2.0 technologies, such as using podcasts and wikis for learning and study, many students appear "neutral" or even display negative views regarding their impacts on learning (Kennedy & Fox, 2013). This could be due to the infrequent use of Web 2.0 technologies in the classroom. For instance, the experience of students in Hong Kong high schools was found to be mainly face-to-face learning, though uploading PowerPoint slides to the Learning Management System was common. Therefore, despite high levels of involvement with technologies outside the classroom, the students did not view Web 2.0 technologies as useful tools which could help to support their studies (Kennedy & Fox, 2013).

In summary, students today are assumed to be "native speakers" (Prensky, 2001, p. 1) in the digital age, and have used Web 2.0 tools extensively, but not all the students are skilled or enthusiastic users of new technologies (Kennedy et al., 2007; Williams & Chinn, 2009). Therefore, it is vital not to make assumptions about students' learning preferences and approaches because such overgeneralizations may lead to the development of problematic policies, money spent on ineffective educational infrastructures, and the design or adoption of inappropriate curriculum and pedagogy based on false assumptions about student needs and experiences (Jones & Healing, 2010).

2.1.2 New possibilities for learning beyond classroom

The emergence of technologies not only has the potential to change the nature of teaching but also of learning in schools (Wu & Beckett, 2011). For example, textbooks can be replaced by interactive web-based multimedia instructions (Brown, 2000; Laurillard, 2008). There are also new forms of presenting information, such as "screen-based" (Brown, 2000, p. 13), or "computational

models of human or natural systems, animated diagrams of theories and concepts, role-play models of events and processes" (Laurillard, 2008, p. 525). Laurillard (2008) argues that the shift from a static to an interactive medium has demonstrated a "radical effect on the act of learning" (p. 525), such as "making the learning process more active and scaling up high quality interactions" (p. 527). With new ways of representation, there is also a possibility of offering a higher level of engagement and developing learners' understanding of difficult concepts (Laurillard, 2008).

With technologies becoming increasingly prevalent in schools (Greenhow et al., 2009), learning has increasingly moved from just reading and listening to active participatory and collaborative learning (Snape & Fox-Turnbull, 2011). In other words, the influence of technology has resulted in learning more frequently being conceived of in terms of "knowledge building", "meaning making" (So, Seow & Looi, 2009, p. 368) and "application of understanding" (Snape & Fox-Turnbull, 2011, p. 149) rather than merely as recalling or embracing "knowledge transmitted by textbooks and teachers" (Goh, Quek & Lee, 2010, p. 90). It is frequently argued that for students to succeed in the 21st century, it is crucial to help them develop higher-order thinking skills (Lambert & Cuper, 2008; McCoog, 2008; State Educational Technology Directors Association, United States, 2011) so that they are able to handle challenging issues, and evaluate and make informed decisions (Brownlee et al., 2009; Walker et al., 2009), especially in this complex and fast growing knowledge society. These skills include critical thinking, analysis and evaluation, creativity and social skills (Magolda & Terenzini, 1999; Gasser, 2011; Luterbach & Brown, 2011; Snap & Fox-Turnbull, 2011) as well as computer literacy skills (Lambert & Cuper, 2008). In view of that, it is important to encourage a constructivist-oriented use of ICT to foster sophisticated epistemological beliefs and advanced learning conceptions (Gerjets & Hesse, 2004; Tsai, 1999).

The affordances of technologies not only have the potential to allow students to collaborate and co-construct information, but they also offer the possibility of flexible and "seamless learning" across different contexts and times (Lim, So & Tan, 2010, p. 368). In other words, learning is not

limited to classroom space or "bounded by time and access issues" (So et al., 2009, p. 370). Such learning may promote autonomous, "self-paced and repetitious" learning (Huffaker & Calvert, 2003, p. 327), where the students have more control over how they learn and the speed at which they learn, allowing them to practise multiple times until the knowledge is mastered.

Luterbach and Brown (2011) believe that learning environments in this digital age should include up-to-date technologies and "fast, continuous and dependable access to [the] internet" (p. 24). Since the middle of the 1990s, internet access has greatly increased in schools, from about 35 percent to 99 percent, and the use of high speed broadband has also escalated (Greenhow et al., 2009). With technologies use more ubiquitous, studies have suggested that as many as 50 percent of instructors have moved from a lecturing style of teaching to pedagogies that involve students' participation (Benzing & Christ, 1997; Laurillard, 2008; Lim et al., 2010). In other words, pedagogies where students are "active participants" while teachers are the facilitators rather than omniscient authorities, are increasingly common (Magolda & Terenzini, 1999, p. 22). This is because more schools are aware that to facilitate higher-order learning (such as knowledge analysis, application, evaluate and synthesis), constructivist-oriented pedagogical practices have to be advocated (Chai et al., 2009a; Gurcay et al., 2013).

Although technology can afford new types of teaching and learning methods, potentially leading to the creation of an "enriched and collaborative learning environment" (Goh et al., 2010, p. 90), other research suggests that few academic institutions actually use technology to its fullest potential to enhance the quality of learning. As posited by Lim et al. (2013), the "in-school technology usage is much less intensive and extensive" (p. 59). This could explain why the students have little to share about how technology can be used to improve learning and also why they expressed satisfaction with the existing learning paradigm (Bullen & Morgan, 2011). Cuban (1993) postulated that technologies "can do what they do well" (p. 198), however, they may not be the most suitable and useful tool for students' learning. Therefore, it is argued that a shift in teaching

and learning should not be led by what technology can do and provide, instead it should be driven by constructivist-oriented pedagogies (Wang & Woo, 2009) and learners' needs (Laurillard, 2008; Lee & Tsai, 2005). As suggested by Chai, Teo and Lee (2010), one's beliefs can serve as "filters that bias" (p. 25) one's practice and learning, including in relation to ICT. It is to this point I turn to by examining students' epistemological beliefs, their learning preferences and approaches to learning.

2.2 Students' epistemological beliefs

Every day we are faced with decisions regarding the new information we encounter at home, work and school. For example, we make decisions about what we read on our digital devices, what to eat, what to purchase, and where to go on weekends. In school, students also make judgements about the new information they face. The methods one uses to acquire new information and skills vary from one individual to another, depending on how one understands the concept of knowledge. In other words, the quest for knowledge is influenced by the epistemological beliefs learners embrace (Erdem, 2008; Tsai & Chuang, 2005).

Before we analyse students' epistemological beliefs, it is necessary to clarify the notion of "epistemological beliefs". Epistemological beliefs refer to learners' views about knowledge and knowing (Cho, Lee & Jonassen, 2011; Chai et al., 2009b; Otting, Zwaal, Tempelaar & Gijselaers, 2010; Stromso & Braten, 2010; Yang & Tsai, 2010a) or, more specifically, one's beliefs about the nature of knowledge and learning (Gerjets & Hesse 2004; Schommer, 1998; Tsai & Chuang 2005; Yilmaz-Tuzun & Topcu 2010). The terms "beliefs about learning" and "beliefs about knowing" are often used interchangeably by many researchers. However, Yilmaz-Tuzun and Topcu (2010) argued that beliefs about knowing are more "abstract" than beliefs about learning. In regards to beliefs about learning and beliefs about knowing, the latter is the more fundamental belief, as it is thought to underpin how one conceives of and approaches learning. For example, it is thought that

students who conceive of knowledge as being more relative, complex and constructed are more likely to regard learning as "an exploration of multiple perspectives" that involves "complex and relativistic thinking" (Marra, 2005, p. 137). Thus, it is argued that they are more likely to adopt deep and meaningful learning strategies, such as rationalising and evaluating their own judgements (Schommer & Dunnell, 1997). On the other hand, students who believe in "simple and dichotomous views of knowledge" (Bendixen & Hartley, 2003, p. 17), are thought to see knowledge as a "collection of known facts" (Marra, 2005, p. 37) and "isolated and unambiguous bits" (Yang & Tsai, 2010a, p. 329). Hence, they tend to memorise facts and are unlikely to look for alternate solutions (Schommer & Dunnell, 1997).

2.2.1 The development of educational research about the epistemological beliefs of learners

The study of personal epistemology started with William Perry's (1968) work on Harvard College undergraduates' perceptions of education (Schommer-Aikins & Easter, 2008). His seminal research, which involved surveys and interviews, was also among the first to study college students' epistemological development (Chai et al., 2009b; Jacobson et al., 2010). In his study, he found that students entering college were more likely to perceive knowledge to be simple, fixed and handed down by authority. As the students progressed to their senior years, they increasingly started to understand that knowledge is uncertain, complex and derived through reasoning (Schommer-Aikins, Mau, Brookhart & Hutter, 2000; Schommer, 1998).

This pattern of epistemological development was also noticed by other researchers, such as Belenky, Clinchy, Goldberger and Tarule (1986), Boyes and Chandler (1992) and Kitchener, Lynch, Fischer and Wood (1993) who built on Perry's (1968) work and examined different aspects of epistemological beliefs. For instance, Belenky et al. (1986) examined women's ways of knowing; Boyes and Chandler (1992) focused on the development of young people's beliefs about the certainty of knowledge; while Kitchener et al. (1993) developed a reflective judgement model

which examined "reasoning about the basis for knowing in relation to ill-structured problem solving" (p. 894). Despite having different focuses, these studies hold a common view that "individuals move through a developmental sequence" (Hofer, 2004, p. 44) that resembles Perry's (1968) account of epistemological development. That is, students in the early stages believe that knowledge is absolute and simple, while students in the middle stage believe that knowledge is uncertain or entirely subjective. In the final, most mature stage of development, students viewed knowledge claims as tentative and fallible but as strengthened by justification and evidence (Schommer-Aikins, Duell & Barker, 2003; Schommer-Aikins, Duell & Hutter, 2005).

These findings were in line with a study conducted by Brownlee et al. (2009). They proposed that as individuals advanced through school or courses of study, their beliefs tended to transform from "absolutism, to multiplism and finally to evaluatism" (p. 602). According to Brownlee, Berthelsen, Dunbar, Boulton-Lewis and McGahey (2008), absolutism means that students perceived knowledge as absolute, fixed and as learnt through simply being transferred from some authority to students. This group of students is also described as having a "static view" of knowledge, that is, as perceiving knowledge to be permanent and complete (Davis, 1997, p. 5). Students with a multiplist perspective believe that knowledge is tentative and is "personally constructed" (Brownlee et al., 2008, p. 138). Such individuals used their own judgement (Magolda, 2002) to make decisions and, thus, were less dependent on authorities for information but tended to embrace a type of naïve subjectivism (Brownlee, Purdie, & Boulton-Lewis, 2001). An evaluativistic epistemological perspective means conceiving of knowledge as changing and uncertain but as obtained through evidence and reason rather than being purely subjective (Brownlee et al., 2008). These students have been described as having a "dynamic view" of knowledge (Davis, 1997, p. 5). This is also demonstrated in Magolda's (2002) study where students who were found to be "independent knowers" (p. 95), not only believed that knowledge was tentative in nature, but they

also constructed new knowledge by modifying their own views in light of the views expressed by others (Magolda, 2002).

Perry's (1968) position that all students pass through a developmental sequence was re-conceptualised in the 1990's by Schommer and his colleagues who found that epistemological beliefs were a system of more-or less independent beliefs rather than coherent belief systems that correlate to universal stages of development (Schommer, 1993; Schommer-Aikins et al., 2003). A belief system encompasses multiple beliefs within an individual's epistemology (Schommer-Aikins et al., 2003; Schommer-Aikins & Easter, 2006). Schommer maintained that "individual beliefs within the system may develop at different rates or may be inconsistent with each other" (Schommer & Walker, 1997, p. 175). In other words, a student could be sophisticated in some epistemological beliefs, but not necessarily advanced in other beliefs. This approach also recognises that epistemological beliefs are context dependent, that is, students may hold sophisticated epistemological beliefs in some contexts but not in others (for example, in relation to some academic disciplines but not others) (Schommer, 1993, 1998; Mori, 1997). Thus, an individual may not be completely located within a single developmental stage of epistemological beliefs, as earlier research implied.

According to Schommer (1998), four distinct dimensions of epistemological beliefs were identified: (a) the extent to which students view knowledge as simple (that is, knowledge as isolated facts as opposed to knowledge as interrelated); (b) the extent to which knowledge acquisition depends on innate ability (that is, the ability to learn is inborn as opposed to developed); (c) the degree of certainty of knowledge claims (that is, knowledge is regarded as fixed as opposed to dynamic and fallible); and (d) the speed of knowledge acquisition (that is, learning is quick or does not take place at all as, opposed to learning takes time and effort). These beliefs have been shown to correlate with associated approaches to learning. For example, studies show that students, who view knowledge as consisting of isolated facts, are more likely to oversimplify information (Schommer

& Dunnell, 1997) and learn by heart (Paulsen & Wells, 1998). On the other hand, if students believe that the ability to learn is innate, they are less likely to accept complex academic tasks (Davis, 1997; Schommer-Aikins et al., 2003; Tolhurst, 2007), while students who believe in quick learning, will persevere to solve difficult problems that require complex processing and thinking skills (Schommer-Aikins & Easter, 2006; Walker et al., 2009). In other words, one's epistemological beliefs are said to have an impact on how one acquires information, solves and interprets problems, as well as their perseverance to learn (Mori, 1997; Schommer, Calvert, Gariglietti & Bajaj, 1997).

Hofer (2004) attempted to extend Schommer's ideas, arguing that epistemology should delineate "the nature of knowledge (what one believes knowledge is) and the nature of knowing (how one comes to know)" (p. 46). In Hofer's (2004) conceptualisation, certainty and simplicity of knowledge concern the nature of knowledge, while the source of knowledge and justification for knowing concern the nature of knowing. Hofer's notions of certainty, simplicity and the source of knowledge are equivalent to those of Schommer but Hofer's notion of the justification for knowing does not directly correspond with any dimensions of Schommer's system of epistemological beliefs. Hofer (2004) defined justification for knowing as how one evaluates and acquires knowledge, such as through identifying and constructing reasons to support knowledge claims. Control and speed of knowledge were excluded by Hofer (2004) because she did not deem these to be essential aspects of epistemological beliefs.

This conceptual framework has also been applied to examine the "issue of domain generality versus domain specificity in epistemological beliefs", showing that epistemological beliefs may differ between subject areas (Braten, Stromso & Samuelstuen, 2005, p. 143). Liang et al., (2010) and Tolhurst (2007) identify the contextual nature of epistemological beliefs, arguing that, discipline specific epistemological beliefs are different from general epistemological beliefs. For example, first year students majoring in subjects such as science, have a tendency to believe that knowledge is more certain and unchanging and is passed on from experts. In contrast, first year

students studying subjects like psychology are less likely to embrace such simple epistemological beliefs (Tolhurst, 2007). Unlike general epistemological beliefs, discipline specific beliefs are not influenced by age (Tolhurst, 2007). This notion of domain specific epistemological beliefs is further supported by Magolda's (2002) study in which students with majors in mathematics and science tended to believe in certain knowledge, while those with majors in the humanities and social sciences tended to believe in ambiguous knowledge and focused on understanding instead of memorizing. In other words, students with majors in subjects such as the humanities, social sciences and the arts tended to hold more sophisticated beliefs than students majoring in subjects like engineering, business and science (Paulsen & Wells, 1998). This suggests that students' epistemological beliefs differ between disciplines, or domains of study (Brownlee et al., 2001; Paulsen & Wells, 1998; Schommer-Aikins et al., 2003).

2.2.2 Dimensions of epistemological beliefs

As described above in relation to Schommer, each dimension of epistemological beliefs refers to a continuum with two extremes ranging from simple to sophisticated beliefs about knowledge (Chan & Elliott, 2004; Schommer-Aikins et al., 2003). Hofer (2004) and Paulsen and Wells (1998) described the structure of knowledge as a continuum ranging from certain and discrete to knowledge as consisting of highly organized "interrelated concepts" (Paulsen & Wells, 1998, p. 368). Likewise, the degree of certainty of knowledge ranges from knowledge as absolute to knowledge as uncertain and changing. The source of knowledge describes a continuum ranging from knowledge viewed as being handed down by an authority, that is, "knowledge as residing outside the self" (Hofer, 2004, p. 46) to knowledge being constructed through a process of justification (Hofer, 2004). The speed of knowledge acquisition is described as ranging from learning that either occurs quickly or not at all (Paulsen & Wells, 1998) to learning that happens progressively. The degree of control over knowledge is a range from the ability to learn as

"uncontrollable" (Paulsen & Wells, 1998, p. 369) and fixed, to the ability to learn as a capacity that can develop gradually. Hofer's (2004) justification for knowing is extended along a continuum from justification through observation and authority to justification as involving the evaluation and integration of information from various sources. One could embrace a mixture of naïve and sophisticated beliefs in any of these dimensions (Brownlee et al., 2001; Brownlee et al., 2009; Cano, 2005; Schommer-Aikins & Easter, 2006; Phan, 2008; Walker et al., 2009). What varies between these beliefs is the proportion attributed to each dimension (Schommer et al., 1997). For example, a student could have strong beliefs that deep learning can be acquired progressively or may believe that knowledge structure is highly complex, integrated and uncertain and, yet, at the same time, see knowledge as consisting of simple, certain and isolated knowledge (Schommer et al., 1997; Schommer-Aikins & Easter, 2006).

Such progression is not only known as a change from naïve to sophisticated beliefs (Walker et al., 2009), but it is also referred to as a move from "dependence on authority to self-authorship" (Magolda, 2002, p. 93) or a matter of having "availing (sophisticated)" as opposed to "non-availing (naïve) beliefs" (Brownlee et al., 2009, p. 602). As defined by Chan and Elliott (2004), availing beliefs are associated with constructivist notions of learning, such as critical thinking and problem solving skills, while non-availing or naïve beliefs are connected to traditional notions of learning. Students with non-availing beliefs are found to be less likely to persist in complex problems (Peng & Fitzgerald, 2006) and tend to do better under close-ended tasks - where solutions are more fixed and explicit instructions are provided (Cho et al., 2011; Tu et al., 2008). Therefore, students who hold availing epistemological beliefs are more likely to succeed academically (Brownlee et al., 2009).

2.2.3 Factors impacting epistemological beliefs

Much of the research (Cano, 2005; Chan & Elliott, 2004; Liang et al., 2010; Paulsen & Wells, 1998; Schommer-Aikins et al., 2003; Walker et al., 2009; Zhu Valcke & Schellens, 2008) shows that one's epistemological beliefs can be influenced by both cultural and contextual factors, for example, demographics (such as age), home environment (like parents' educational level), as well as the level and nature of one's own educational experiences. In this section, the possible factors that may shape students' beliefs about knowledge and knowing are discussed.

It was stated earlier that as students' progress through their study, they typically cultivate more advanced epistemological beliefs, which leads to more sophisticated learning techniques, including better critical thinking and problem solving skills (Schommer-Aikins et al., 2003). This is further supported by studies conducted by Cano (2005), and Walker et al. (2009) where the higher the educational level of students, the more complex are their epistemological beliefs. For instance, students who are in their senior year are more likely to believe in complex and uncertain knowledge that is learnt progressively through reasoning and constructing knowledge (Chan & Elliott, 2004; Magolda, 2002; Schommer-Aikins et al., 2003), whereas students at the start of education are more likely to believe in "simple and certain knowledge" (Schommer-Aikins et al., 2003, p. 104), which can be transferred from the experts to the learners. This, therefore, suggests that "maturation" (Cano, 2005, p. 205) and one's level of educational attainment contribute to their development of epistemological beliefs.

In addition, epistemological beliefs can be influenced by one's home environment, including the parents' educational background (Paulsen & Wells, 1998; Walker et al., 2009). According to Schommer-Aikins (2004), families have their own "cultural views, ways-of-knowing beliefs and epistemological beliefs" (p. 26), which tends to reflect the educational experiences of the parents and is often passed on to their children. Thus, a child's epistemological beliefs can be influenced by their parents' educational background. As indicated earlier, individuals with higher levels of

educational attainment tend to have more sophisticated beliefs than those with lower levels (Cano, 2005). Therefore, it is plausible that students whose parents have higher education levels would also embrace more advanced epistemological beliefs and demonstrate higher order thinking skills, such as reflective, evaluative and analytical skills (Walker et al., 2009).

As explained earlier, teaching approaches, such as teacher-centred teaching and student-centred teaching, also appear to have a significant effect on students' epistemological beliefs (Cano, 2005; Zhu et al., 2008). In a traditional teacher-centred learning environment, teachers explain or dictate while students observe and reproduce teacher explanations. Such classroom practices are more likely to result in passive learning, a high reliance on experts for information and not taking ownership of their own learning (Tolhurst, 2007). This, therefore, not only limits students' learning abilities, but it also hinders the development of students' independent, self-directed and critical reflective thinking skills. In line with this reasoning, Liang et al. (2010), Tolhurst (2007), as well as Zhu et al. (2008), posit that students who are engaged in traditional learning environments are unlikely to adopt either deep learning approaches or seek additional information in the process of learning. This in turn may affect their academic performance.

Contrary to traditional teaching approaches, constructivist pedagogies are thought to promote the development of more sophisticated epistemological beliefs (Corte, Op't Eynde & Verschaffel, 2002; Ogan-Bekiroglu & Sengul-Turgut, 2008; Paulsen & Well, 1998; Zhu et al., 2008). In a constructivist classroom, learning is not only achieved through collaboration, interaction and discussion (Gerjets & Hesse, 2004), but there is also an emphasis on the use of "complex, realistic and challenging problems" (p. 449), as well as technological tools. According to Gerjets and Hesse (2004), "complex, realistic and challenging problems elicit active and constructive processes of knowledge and skill acquisition in learners" and technological tools are regarded as the "facilitators of constructive learning" (p. 449). Therefore, students, who are immersed in these learning environments, not only hold higher-order learning skills (Brownlee et

al., 2008), but they also tend to value education and perceive learning to be more than just memorizing facts and formulas (Zhu et al., 2008). With respect to this, they are believed to possess a higher degree of perseverance when it comes to tackling challenging tasks (Zhu et al., 2008), as well as higher motivational beliefs, in relation to "goal orientation beliefs" and "task value beliefs" (Corte et al., 2002, p. 307).

Paulsen and Wells (1998) and Tolhurst (2007) also proposed that epistemological beliefs can also be shaped by learning tasks and assessment methods. It is believed that the nature of instruction and assessment are influenced by teachers' epistemological beliefs (Schommer-Aikins, 2004; Chai et al., 2009b; Chai, et al., 2010). For example, if a teacher views "knowledge as facts and knowing as a process of facts acquisition" (Chai et al., 2009a, p. 118; Schommer-Aikins, 2004), they are likely to use lower level assessment such as multiple choice tests for their assessment. Students who are engaged in such assessment tasks are likely to believe that knowledge is not only absolute, but it is also learnt by memorizing and reproduction. These students may also be encouraged to form naïve epistemological beliefs over time. Conversely, if a teacher believes in constructivist learning, they are more likely to use constructivist-oriented learning activities and higher level assessment where students engage in the synthesis and application of knowledge (Chai et al., 2009a; Chai et al., 2010). In doing so, students may alter their beliefs, which may in turn foster more sophisticated epistemological beliefs and decrease their "unquestioning acceptance of an expert's word, which ultimately lessens their passivity as learners" (Schommer-Aikins, 2004, p. 26). Therefore, to influence and develop students' sophisticated epistemological beliefs, constructivist activities which promote developing problem solving skills should be adopted (Tolhurst, 2007).

Home, schools and peers are not the only factors that may have an effect on the development of epistemological beliefs. Other factors, such as culture, may also influence one's beliefs. Yilmaz-Tuzun and Topcu (2010) refer to these as second level influences. One such second

level influence appears to be the impact of Confucianism on epistemological beliefs in some Asian societies. Due to the influence of C*onfucian* teachings, "Asian parents have higher expectations and are more involved in their children's learning" (Liang et al., 2010, p. 45). Likewise, Asian students, who are brought up in a conventional teaching and learning environment that stresses "effort, endurance and hardwork" (Chan & Elliott, 2004, p. 827), have a greater desire to achieve more (Chan & Elliott, 2004; Liang et al., 2010; Zhu et al., 2008) and regard "respect and obedience" (Zhu et al., 2008, p. 414) as essential values for academic success. With such values being inculcated into many Asian students, they are widely believed to be more obedient in that they do not question their teachers or parents, but follow what their parents and teachers think are good learning approaches for them (Liang et al., 2010). Western students, on the other hand, are thought to place a greater value on "creativity" (Zhu et al., 2008, p. 414) and emphasise the process of learning as opposed to just the content to be learnt. Unlike Asian students, they have a greater tendency to question the "source of knowledge" (Zhu et al., 2008, p. 414), rather than merely accept what is prescribed to them. According to this view, cultural values could be considered to have an effect on "parental expectations" (Liang et al., 2010, p. 45), students' goals for learning, and expectations about their learning experiences, which in turn, influences students' beliefs about knowledge and knowing (Chan & Elliott, 2004; Liang et al., 2010; Zhu et al., 2008).

In summary, one's epistemological beliefs can be influenced by educational contexts, family and cultural backgrounds, and this in turn may affect one's learning conceptions and approaches (Brownlee et al., 2009; Corte et al., 2002; Davis, 1997; Walker et al., 2009). The next section discusses students' conceptions of learning and the various possible factors affecting one's conceptions of learning.

2.3 Students' learning conceptions

While the studies on conceptions of learning and epistemological beliefs reiterate and extend many of the same points, they refer to different but related bodies of literature. The latter looks at students' beliefs about knowledge, while the former looks at their beliefs about learning, which helps us understand how students actually approach learning. For this reason, both are important to my research and both bodies of literature guided my own data collection and analysis. In this section, students' conceptions of learning, particularly the different categories of learning, will be discussed.

2.3.1 Conceptions of learning

Byrne and Flood (2004) describe conceptions of learning as "the way in which a person views learning" (p. 26). One's conceptions of learning are not only built based on their authentic learning experiences, but it is also assumed that their experiences in different domains may guide them to different concepts about learning within those subjects (Chiou & Liang, 2012; Lin & Tsai, 2009; Tsai & Kuo, 2008; Wang & Tsai, 2012). For example, as we saw with the literature on epistemological beliefs, students learning Science may embrace a conception of learning that is different from students learning History. That is, students who view historical knowledge as certain, may perceive learning history as memorizing, while students who see scientific knowledge as uncertain, may view learning science as seeing something in a different way (Lee, Johanson, & Tsai, 2007). Such conceptions would then affect the ways they learn or prefer to learn. This, therefore, supports the claim that students' learning conceptions are influenced by their epistemological beliefs, which in turn influences the adoption of their learning approaches (Lee et al., 2007; Zhu et al., 2008).

For research about conceptions of learning, Saljo (1979) was the forerunner (cited in Chiu, 2011; Lee et al., 2007; Tsai, 2004a; Tsai, 2009). In his seminal research on the examination of

students' views about learning, he identified five different conceptions of learning, namely: (a) learning as an increase of knowledge; (b) learning as memorizing; (c) learning as the acquisition of facts or procedures that can be retained and/or utilized in practice; (d) learning as the abstraction of meaning; and, (e) learning as an interpretative process aimed at the understanding of reality.

Such concepts of learning were also noticed by others, such as Marton et al. (1993), cited in Eklund-Myrskog (1997), and Tsai (2004a, 2004b, 2009). The five conceptions of learning identified by Marton et al. (1993) were similar to those identified by Saljo. In addition, Marton et al. also identified a new conception of learning, which they referred to as "personal change" (cited in Eklund-Myrskog, 1997, p. 372). Marton described this sixth conception of learning as the ability to reflect on one's own changes and as having an increased understanding of themselves (cited in Marshall, Summers & Woolnough, 1999). The sixth conception is an extension of Saljo's fifth conception of learning (that is, learning as an interpretation of reality), which involves the ability to analyse and apply knowledge to new situations in the real world and allows one to see things in their own way. As such, it is found to be more common in students who exhibited Saljo's fifth conception and is also largely found during the later stages of education (Klatter, Lodewijks & Aarnoutse, 2001; Tynjälä, 1997). In other studies conducted by Tsai (2004a, 2004b, 2009), two further categories of learning, which were found to be most prominent within the science domain, were identified. These are learning as primarily a means of preparing for tests and learning as a process of calculating and practising tutorial problems. These categories are presented in Table 1 below:

Table 1 - Conceptions of learning proposed by key researchers (adapted from Tsai, 2004a)

Range of Conceptions	***Saljo (1979) and Marton et al. (1993)***	***Tsai (2004, 2009)***
Constructivist ↑	6. Changing as a person	7. Seeing in a new way
	5. Seeing something in a different way	6. Understanding
	4. Abstraction of meaning (or understanding)	5. Applying
	3. Acquisitions of facts or procedures that can be retained and/or utilized in practice (or applying)	4. Increasing knowledge
	2. Memorizing	3. Calculating and practicing tutorial problems
	1. Increase of knowledge	2. Preparing for tests
Reproductive		1. Memorizing

Judging by the categorization, illustrated in Table 1, the learning conceptions found in these studies denote a "developmental hierarchy" (Klatter et al., 2001, p. 486). That is, these conceptions develop from lower order "reproductive" conceptions of learning to higher order "more constructive conceptions of learning" (Marshall et al., 1999, p. 305), where the higher order conceptions of learning exist in the upper level and the lower order conceptions occur in the lower level (Lin & Tsai, 2009). Like students' epistemological development, these conceptions of learning typically advance progressively through educational experiences (Loyens, Remy & Schmidt, 2008).

The lower order reproductive conceptions of learning include Saljo and Marton's first three categories, that is, learning as a means of increasing one's knowledge, memorising and acquisition of knowledge which can be retained/used in practice (Dart et al., 2000), as well as Tsai's (2004a, 2004b) first four conceptions of learning (which are learning as a process of memorizing, preparing for test, practising tutorial problems and increasing knowledge). These conceptions are concerned with the acquisition, accumulation and application of information, and, thus, reflect a more quantitative view of learning. As these conceptions of learning are focused on collecting large volumes of information, learning outcomes are measured by the quantity of information gathered

instead of the quality of that information (Pillay & Boulton-Lewis, 2000). In other words, they are concerned with "how much is learned" (Tsai & Kuo, 2008, p. 356). Students with such conceptions not only emphasise acquiring and accumulating content (Lee et al., 2007; Lin & Tsai, 2009), but they also believe that the more they have obtained the more adept they will be in educational, professional and everyday contexts. Ellis, Goodyear, Calvo and Prosser (2008) also advocated that such a "passive, transmissive view of learning" (Chiou & Liang, 2012, p. 85) is suggestive of students with a lower quality learning experience, which underscores reproduction instead of understanding.

In contrast, the more advanced (three) conceptions of learning (that is, learning as applying, understanding and seeing in a new way/changing as a person) involves a "process of transforming what students have perceived into a meaningful whole" (Chiou & Liang, 2012, p. 85) and denote a constructivist view of learning (Lee et al., 2007; Dart et al., 2000). These constructivist conceptions of learning focus on understanding and relating new content to prior knowledge, and suggest a qualitative view of learning (Boulton-Lewis, Marton, Lewis & Wilss, 2000; Lin & Niu, 2011). In brief, they are less concerned with how much is learned and focus rather on "how well it is learned" (Tsai & Kuo, 2008, p. 356; Lin & Tsai, 2008a, 2008b). Students with such learning conceptions focus on the "active process of seeking meaning, leading to some kind of transformation in one's view of things, or of the self" (Marshall et al., 1999, p. 292). Students with such "transformative" views (Lin & Tsai, 2008b, p. 563) tend to have a "better quality of learning" (Tsai, 2009, p. 1101) than those who view learning as memorizing or recalling lots of information (Fuller, 1999).

The conceptions of learning are not mutually exclusive. According to Chiou and Liang (2012), a student may embrace multiple conceptions of learning at any one time. For example, one may regard understanding as important in their learning, but they may also consider memorizing important information as essential. Although one may hold more than one conception, the

weighting between the two conceptions may be developed at different levels, that is, one conception of learning may be more dominant than the other (Lin & Tsai, 2008a, 2008b).

2.3.2 Categorization of the students' conceptions of learning

The previous sub-section presented a brief overview of the different categorizations of students' conceptions of learning. This sub-section describes each of these categories in more detail in order to provide a better understanding of what each of the conceptions of learning entails and might actually look like in practice.

(a) Conception A: Learning as the increase of simple knowledge

As mentioned earlier, knowledge can be conceived of as either complex (for example, consisting of a complex, integrated network of ideas) or simple (such as consisting of discrete, isolated facts). If knowledge is viewed as complex, then an increase of knowledge would be regarded as involving higher order thinking and deep learning. However, if knowledge is simple then an increase in knowledge would just involve memorising more facts, not necessarily higher order thinking. In view of this, the original notion of *learning as the increase of knowledge* is somewhat ambiguous and may be misleading because it could actually denote either lower order or higher notions of learning depending on how knowledge itself is conceived. To avoid any confusion and misperception, the category in this study has been renamed *learning as the increase of simple knowledge*.

According to this conception, learning not only involves the "acquisition and accumulation" (Lee et al., 2007, p. 213) of discrete pieces of information, but it is also seen as reproductive (Byrne & Flood, 2004). In other words, students holding this view tend to acquire and reproduce what they have learnt in class, rather than build on, critique, reinterpret or connect that information to other ideas or information. Furthermore, such learners also have a tendency to focus more on the volume

and quantity of what is learnt rather than on relating and applying their knowledge to practice and concrete situations (Tsai & Kuo, 2008). Hence, such learning often has a quantity flavour to it (Byrne & Flood, 2004; Watkins & Akande, 1994) and is external to the learner (that is, not integrated within their own perceptions and world view).

However, Tsai (2004a) further argued that such learning can also be an element of more advanced learning goals and approaches, such as a student's "personal desire for learning" (p. 1744) or personal growth. Their personal desire for learning would stimulate the students to acquire more new knowledge or information which they would build on and transform later. As such, this conception cannot be entirely characterised as a reproductive view of knowledge because students embracing this conception could possibly be using it as a kind of stepping stone to deeper learning approaches. Thus, it depends on whether students are using such a learning approach in isolation or in conjunction with other learning approaches.

(b) Conception B: Learning as memorising

Within this conception, learning is described as the memorization and storage of definitions, equations, procedures and terms with a primary purpose of reproducing them for examinations (Lee et al., 2007; Watkins & Akande, 1994). Consequently, students' views and their goals of learning are largely governed by the schools' needs and expectations (Eklund-Myrskog, 1998).

Like the 'increase in simple knowledge' conception of learning, this conception has a quantity flavour to it, as it emphasises the volume and quantity of material learnt, rather than relating to, and applying, knowledge (Byrne & Flood, 2004; Marshall et al., 1999). While both Conception A and Conception B focus on the volume and the ability to store and reproduce the information learnt, they are different from one another in respect to the acquisition of the information. As mentioned in Conception A, successful learning can be achieved using a learning approach in isolation, or in conjunction with, other learning approaches. In general, it is achieved

through surface learning approaches, such as rote memorization or drill and practice but may also be a stepping stone or aspect of more sophisticated approaches to learning (Byrne & Flood, 2004; Purdie, Hattie & Douglas, 1996).

For example, Cliff (1998) has argued that memorization may sometimes be associated with "meaning-making and developing understanding" (p. 207). For instance, undergraduate students in Hong Kong, who viewed understanding as an important aspect in learning, used deep memorization approaches, such as rote learning, in conjunction with understanding, as a way to acquire knowledge (Chan, 2011). Through such learning, these students were not only able to comprehend the information, but they were also able to manage their learning better and retain what they had learnt in school, thus, leading to the students having greater confidence and motivation (Chan, 2011). Hence, the two conceptions - "learning as understanding" and "learning as remembering and producing" (Chan, 2011, p. 105), are not conflicting or exclusive, but rather they may complement one another and other, higher order aspects of learning.

(c) Conception C: Learning as the acquisition of facts, procedures, etc., which can be retained and/or used in practice (or Applying)

Students who held this conception of learning viewed learning as the "application of received knowledge" (Tsai, 2004a, p. 1740; Byrne & Flood, 2004) to practical contexts. By application, I mean "retrieving and adapting what has been learnt and using it in a wide variety of circumstances" (Byrne & Flood, 2004, p. 27), as opposed to merely retaining it so as to repeat the knowledge for assessment purposes (Tsai, 2004a, 2004b; Watkins & Akande, 1994). While the emphasis is on the ability to apply and use learnt content in a wider context, there is no active sense-making activity involved (Marshall et al., 1999). The focus is on knowing how to use the formulas and procedures through repeated and habitual doing and applying (that is, learning

through drill). Thus, this is the reason that this conception is classified as a reproductive conception quantitative view of learning (Lee et al., 2007).

However, as with the concepts of learning previously explained, this notion of learning may be utilised as an aspect of more sophisticated learning approaches. For example, one study has shown that students embracing this conception of learning were more likely to have mixed learning motives, that is, both surface and deep motives to learning. That is, students could have an inherent interest in learning and, at the same time, have extrinsic aims, such as getting into good universities or acquiring a better job (Lee et al., 2007).

According to Marshall et al. (1999), the move from a "passive intake of knowledge" (p. 297), as shown in learning conceptions A and B, to applying and using the knowledge (as described in learning conception C), shows "growing activity" (p. 297) on the learner's part because the learner is taking the knowledge and putting it to further use rather than just storing it away. With this conception of learning, the students perceived the knowledge or skills as more meaningful because they can use it now or at a later stage and also for a specific or non-specific purpose (Purdie et al., 1996).

(d) Conception D: Learning as preparing for tests

As mentioned earlier, in a study conducted by Lin and Tsai (2009), they identified two new distinct categories of learning in addition to the first six conceptions detailed in Table 1. The first of which is learning as "preparing for tests" (Tsai, 2009, p. 1093). Students in this category viewed extrinsic learning as primarily a means of studying and getting ready for examinations. As such, their learning largely involved becoming familiar with course materials (Chiou & Liang, 2012) as a means to attaining high scores in examinations (Lee et al., 2007). Thus, for this conception of learning, test grades become the evaluating criteria of the learning outcome (Purdie et al., 1996).

(e) Conception E: Learning as calculating and practicing tutorial problems

The other category identified by Tsai (2009) is learning as "calculating and practicing tutorial problems" (Tsai, 2009, p. 1093). Within this conception, students regard learning as a "series of calculating, practicing tutorial problems and manipulating formulae and numbers" (Tsai, 2004a, p. 1739). This conception is largely shaped by how teaching and learning activities are carried out and appears to be more prevalent within some disciplinary areas than others. For example, Mathematics and Science are often presented in terms of equations, formulas and procedures. In addition, these subjects are also often taught using drill and practice. Due to the learning environment the students are exposed to, learning in these subjects is sometimes seen as a quantitative process and "as a process of obtaining familiarity" (Tsai, 2004a, p. 1740) through repeated calculations and practices. In other words, students see learning as the ability to "use correct formulae and numbers" (Chiou & Liang, 2012, p. 86) and as resulting from the "intensive practice of tutorial problems", in order to learn better and to achieve their learning goals (Tsai & Kuo, 2008, p. 362). This may result in students being very adept at solving a question but they may not really understand the nature or meaning of the problem. In short, students with this conception perceive learning as giving precise answers without deep understanding (Tsai, 2004a, 2004b).

(f) Conception F: Learning as the abstraction of meaning (or Understanding)

While the emphasis in this conception is still on the application of knowledge, it is understanding or the significance of the knowledge to be learnt that is emphasised, as opposed to the more habitual and less reflective application associated with the previous conception of learning (Watkins & Akande, 1994). This conception of learning involves some transformation of what is learnt and is similar to Eklund-Myrskog's (1998) fifth category of learning, which is, "learning in terms of forming a conception of one's own" (p. 307). As such, this conception of learning can be characterised as a constructivist or qualitative view, where students not only see learning as "the

ability to apply based on understanding" (Eklund-Myrskog, 1998, p. 306), but they also "internalize learning and view it as a personal experience" (Byrne & Flood, 2004, p. 28). Such views are more prevalent amongst students who are near the end of a course of study.

This conception of learning is different from conceptions A, B, and C in that learning involves some form of sense-making. Sense-making means reflecting on one's learning and having questions or constructing imageries of learning activities within one's mind, which then guide a re-assessment of the learning material. This process of sense-making is moderated by a reflective dimension of learning (Marshall et al., 1999). Therefore, students holding this view not only use deep learning approaches and embrace deep learning motives (Dart et al., 2000; Tsai, 2004a, 2004b) but they are also more involved in their learning process.

Byrne and Flood (2004) also postulated that students embracing this view recognize the significance of applying and relating what they have learnt to new contexts or situations. In other words, students tend to believe in real understanding as opposed to merely learning through remembering and repetition. For example, they maintain that when one has achieved real understanding, memorization is not required (Tsai, 2004a, 2004b). Consequently, successful learning is measured in terms of the ability to understand what they have learnt, the ability to explain it to friends, as well as the ability to use what has been learnt to solve problems (Marshall et al., 1999).

(g) Conception G: Seeing something in a different way

With the previous conception of learning (that is, conception F), learning was largely confined to the classroom context, for instance, understanding concepts in the course material. In contrast, this conception of learning of seeing something in a different way takes place in the "real world" (Byrne & Flood, 2004, p. 28). For example, learning helps one to discover a better way to see the world differently (Lee et al., 2007; Chiou & Liang, 2012). Such a skill as interpreting the

world around them in new ways is not acquired immediately but at a later stage (Eklund-Myrskog, 1998).

This could be the same as Marshall et al.'s (1999) conception of "learning as seeing in a new way" (p. 301). In Marshall et al.'s (1999) conception of learning, it is described in terms of being able to apply and relate what they have learnt to various contexts and situations in real-life, and this is acquired through real-life experiences. Since this skill is regarded as the ability to analyse and apply knowledge to new situations in the real world and allows students to see things in their own way, it is, thus, an extension of the problem solving skill in conception F (Marshall et al., 1999).

(h) Conception H: Learning as changing as a person

Conception H differs from, and extends on conceptions F and G in that learning is now experienced as a change in person. That is, when one works with other students, or interacts with the learning materials, one acquires new perceptions and views things differently. This consequently leads to change in a person that involves seeing themselves differently and having their own perceptions of the world around them (Byrne & Flood, 2004; Marshall et al., 1999). Such a change is also described by Marshall et al. (1999) as the "personal transformation" conception of learning (p. 304). Like conception F, this process of transformation is mediated by a reflective dimension of learning, that is, students embracing this concept and reflecting on their "own changes as a person" (p. 304), results in an increased understanding of themselves (Marshall et al., 1999).

In addition to the above conceptions, other researchers have started to see the importance of examining the 'why' aspect of learning, that is, the reasons for learning (Peterson, Brown & Irving, 2010). As a result, several more conceptions of learning have been identified. These include learning as the development of social competence (Purdie & Hattie, 2002; Tynjälä, 1997) and learning as a duty versus lifelong learning (Dahlin & Regmi, 2000; Dahlin & Watkins, 2000). In the category of learning as the development of social competence, learning is not only viewed as an

"interactive process" between students and teachers (Tynjälä, 1997, p. 287; Purdie & Hattie, 2002), but it also involves thinking and processing activities and is aimed at developing the skills and knowledge needed to be socially competent (Tynjälä, 1997). As mentioned earlier, it is important to help students develop higher order thinking skills such as social skills (Magolda & Terenzini, 1999; Gasser, 2011; Luterbach & Brown, 2011; Snap & Fox-Turnbull, 2011), so that they can succeed and fit in this complex society. In the latter conception, which is learning as a duty versus lifelong learning (Dahlin & Regmi, 2000; Dahlin & Watkins, 2000), Peterson et al. (2010) found that students who regard learning as "a continuous or lifelong process" (p. 174) tend to have higher learning outcomes than students who viewed learning as a duty.

In summary, conceptions A, B, C, D and E are more related to reproductive and quantitative learning as they focus more on the amount of knowledge being obtained. According to Purdie et al. (1996), there is little integration in these conceptions. The main emphasis is on storing, accumulating and replicating new knowledge in the memory (Lin & Niu, 2011). Conceptions F to H involve a more "active process of seeking meaning" (p. 292), thus resulting in the change in one's view of things (Marshall et al., 1999). Students holding these conceptions tend to restructure their knowledge and apply and relate the information to other situations or contexts (Tsai, 2004a).

As mentioned earlier in section 2.1.2, learning in the 21st century is more about "knowledge building", "meaning making", and "active and participatory learning" (So et al., 2009, p. 368). In view of that, it is important to foster higher level conceptions that develop higher-order thinking skills. However, reproductive and quantitative conceptions, such as the conceptions of learning as testing and learning as calculating and practising are also important because, among other things, assessments still play an important role in 'measuring' how well a student performs in school and their opportunities for further study (Tsai, 2004a, 2004b). Furthermore, such lower order approaches to learning are often elements of deeper learning approaches anyway. Consequently, by understanding these conceptions, not only does it help educators to shape more advanced

conceptions about teaching and learning, it also restrains educators from focusing on and only using lower level assessment, such as, multiple choice tests, which may encourage students to continue using surface approaches (Lee et al., 2007).

Like epistemological beliefs, studies show that one's views about learning could be influenced by different determinants (Chan, 2011; Lin & Tsai, 2009; Malie & Akir, 2011; Tsai & Kuo, 2008; Wang & Tsai, 2012). In the next sub-section, I will discuss the possible factors that may affect one's conceptions of learning.

2.3.3 Factors impacting students' conceptions of learning

Previous studies have revealed that various components, such as classroom teaching (Chan, 2011; Kek & Huijser, 2011), learning environments (Lin & Tsai, 2009; Trigwell & Ashwin, 2006), students' previous learning experiences (Wang & Tsai, 2012), educational contexts (Tsai & Kuo, 2008), students' epistemological beliefs (Chan, 2011), and Chinese culture (Chan, 2011) have significant effects on students' conceptions of learning. Examining the different determinants that may shape one's views provides a good starting point to develop understanding of what affects students' conceptions of learning, as well as how, and to what extent, these conceptions influence their approaches to learning. In this section, each of these factors will be discussed in detail.

Some studies have shown that classroom teaching is significantly related to learning conceptions (Kek & Huijser, 2011; Klatter et al., 2001). For example, a study conducted by Wang and Tsai (2012) revealed a large proportion of the students tend to embrace traditional conceptions of learning and regarded items like, chalkboards (69.6 percent), desks and chairs (77.5 percent), books (59.8 percent), learning content (52.9 percent) and the presence of teachers (53.9 percent) as essential elements for learning. Such conceptions could be attributed to the continued prevalence of various "didactic variables" (Wang & Tsai, 2012, p. 616), such as, "transmission teaching approaches" (Streitwieser & Light, 2010, p. 347) and other learning activities that facilitate surface

learning strategies (Kek & Huijser, 2011). For example, 53.5 percent of the students indicated that the learning activities they engaged in were primarily passive, such as listening to lectures (Wang & Tsai, 2012). Moreover, Tulodziecki and Grafe (2012) reported that although there has been an increase in the use of computers and the internet, very few teachers are actually using technology in their lessons, thus, exhibiting a lack of technological integration in the classroom. All these findings indicate that students have been introduced to "learning and teaching situations which demand superficial learning" (Kek & Huijser, 2011, p. 203) and little integration of digital media. Such learning environments could be one of the main reasons for perpetuating students' traditional perceptions that is, learning take place in a classroom environment, where teachers lecture in front of the class and students listen.

In other studies, it was found that learning environments, such as objectives, assessments, good teaching, work-load and independent learning (Ramsden, 1991), may result in different conceptions of learning (Trigwell & Ashwin, 2006; Tynjälä, 1977). For instance, a constructivist environment, which focuses on "self-regulated learning, independent, critical and creative thinking" (Chan, 2011, p. 104), is more likely to encourage students to construct knowledge actively and develop higher level views, such as "applying, understanding and seeing in a new way" (Lin & Tsai, 2009, p. 200). In contrast to student-centred learning, a classroom environment which underscores remembering and reproducing facts and formulas may result in passive learning (Lin & Tsai, 2009) and prompt the development of lower level views, such as those focused on memorizing facts, preparing for examinations and practising tutorial questions (Chan, 2011). However, a study conducted by Evans and Kozhevvnikova (2011) showed that a change in assessment design with the aim of encouraging students to use "deeper and more self-regulated/directed approaches to learning" (p. 134) does not necessarily mean that every student will know how to use deep approaches to achieve their goals. This means that existing students' beliefs and perceptions in

conjunction with their learning context appear to have a significant impact on individual change or one's learning behaviour (Evans & Kozhevvnikova, 2011).

A study conducted by Wang and Tsai (2012) revealed that students' learning activities became less varied as they advanced to higher grades. In other words, students' conceptions of learning varied with their learning experiences. For instance, as students progressed to higher grades, their conceptions of "learning locations" (p. 615) changed from informal and outside of a classroom to formal and within a classroom. Furthermore, the time spent doing these learning activities, such as reading, writing and discussing, also reduced while that of listening to lectures increased significantly. This, therefore, suggests that students tend to hold increasingly conventional images of learning as they progress through the grades (Colley, Mulhern, Relton & Shafi, 2009; Chambers, 1983; Wang & Tsai, 2012). Wang and Tsai (2012) further speculated that students' traditional conceptions of learning, for example, teacher-centred learning, might be shaped by their "increasing but monotonous learning experiences" (p. 616).

Furthermore, educational contexts play an important role in students' conceptions of learning (Tsai & Kuo, 2008). For example, Eklund-Myrskog (1997, 1998) found that students at the end of their program of study do not only associate learning with "practical working situations" (Eklund-Myrskog, 1998, p. 314), but they also realize the importance of learning with understanding in their future work due to the training and experience they have undertaken. This explains why students at the end of an educational program tend to embrace a more qualitative conception, such as learning with understanding, than those at the beginning of the program.

In a study which examined Hong Kong preservice teacher education students' epistemological beliefs and conceptions of learning, Chan (2011) showed that epistemological beliefs, particularly beliefs about the learning effort/process, had a significant effect on both reproductive and constructivist views of learning. The beliefs of these students was thought to be influenced by traditional Chinese culture or Confucianism, which stresses hard work and effort, the

value of respecting authorities, as well as the process of thinking and understanding rather than merely reading or memorization. Given that the majority of Asian students are brought up in such a traditional environment, students tend to believe that the attainment of knowledge or learning is a process that involves understanding and effort. Based on the description of each category in section 2.3.2, the process of thinking and understanding is more related to a "constructive" and "qualitative" view of learning (Byrne & Flood, 2004, p. 28), while the process of effort and hard work reflects a more quantitative notion of learning. Such beliefs not only drive one's learning but they are also significant contributing factors to one's conceptions of learning (Chan, 2011).

Furthermore, Tsai (2009) has suggested that web-based pedagogies could be a possible means for fostering the development of students' sophisticated conceptions of learning. This claim is supported by past research which shows that educational technology can promote effective learning, proliferate learners' critical understanding and develop learners' higher order skills (Dori & Belcher, 2005; Lim & Barnes, 2005). In section 2.2.3, a discussion was presented about how the learning environment can support and influence the development of more sophisticated epistemological beliefs (Corte et al., 2002; Erdem, 2008; Ogan-Bekiroglu & Sengul-Turgut, 2008; Paulsen & Well, 1998; Zhu et al., 2008). Likewise, students' conceptions of learning can also become more advanced with the provision of appropriate learning settings and instructional approaches. This has been demonstrated in Tsai's (2009) study where students' learning conceptions were influenced by the learning context. For example, findings showed that students in web-based learning environments embraced more advanced or complex conceptions of learning. That is, they viewed web-based learning as involving "applying" knowledge and "seeing in a new way" (p. 1101). In view of this, it is crucial to create a learning environment that integrates technology into the programs and fosters deep and flexible learning amongst students. As posited by Richardson (2011), "educational interventions will not be effective in changing students'

approaches to studying unless they serve to bring about changes in the students' perceptions" (p. 289).

Now that I have discussed students' views about learning, I now turn to discuss how students approach learning and the various possible factors affecting one's learning approaches.

2.4 Students' learning approaches

While there are many benefits to adopting technology in the classroom, for example, "greater flexibility", "seamless integration of face-to-face and online interaction", "opportunities for community building among students" (p. 197) and support for collaborative learning (So & Bonk, 2010), in itself, technology does not necessarily promote the development of higher-order thinking skills. As postulated by Wu and Beckett (2011), the importance of integrating technologies is not only a matter of considering "what ICT is used, but also how it is used" (p. 8). In this fast changing society, informed learners with higher competencies are essential. Gijbels, Segers and Struyf (2008) claimed that in order to attain these goals, deep approaches to learning should be adopted. This can be attained by implementing constructivist learning environments, with the intent of developing the skills to think critically, engage in analysis and apply one's knowledge (Almeida, Teixeira-Dias, Martinho & Balasooriya, 2011). Therefore, to improve the quality of learning experiences and due to the diverse learning approaches and learning preferences embraced by the individual students, it is important to have deep understanding and insights into how students learn (Wishart, 2005). As stated by Case and Gunstone (2003), it is not just a matter of how a lecturer outlines a course's content and sequence, but also of how learning is conceived of by the students.

Previously in section 2.3, I explained the different conceptions of learning. These sub-sections that follow present students' approaches to learning, how the different domains of study influence their approaches to learning and the possible factors affecting one's learning approaches.

Approaches to learning are denoted as the techniques or ways which students use to learn or perform a task (Liang et al., 2010; Rodriguez & Cano, 2007). According to Chiou and Liang (2012), students may use different ways to learn depending on the academic subjects. Consequently, the nature of one's learning approaches is domain-specific. The initial research about approaches to learning originates from the study of Marton and Saljo (1976) (cited in Lee et al., 2007; Phan, 2008). In their study, two main approaches, namely deep and surface approaches, were identified.

A deep approach is regarded as an intrinsic motivation to seek the meaning and understanding of the course material (Gijbels et al., 2008), for example, comprehending the knowledge thoroughly and reflecting on the meaning of the text (Cheng & Tsai, 2012; Rodriguez & Cano, 2007). In other words, the concept of deep learning involves understanding and relating new ideas to previous knowledge (Abhayawansa & Fonseca, 2010; Evans, Kirby, & Fabrigar, 2003; Phan, 2008). It was also found that learners embracing a deep approach would be more willing to take part in all activities suggested by their teachers. For example, they would participate in voluntary activities that might contribute to their overall assessment grades and online forums where they could learn from their classmates and teachers through discussion. In short, students embracing deep approaches not only display "intrinsic interest in these activities" (p. 164) but they also have a higher preference for learning approaches that require deep reasoning (Almeida et al., 2011).

Students using a deep learning approach are generally active learners, embracing more constructive views of their educational environment (Richardson, 2011) and have the ability to change between deep and surface learning approaches according to the demands of the specific learning task (Almeida et al., 2011). Hence, the use of approaches to each subject may vary. For example, students may use deep approaches to learn science but depend on surface approaches, such as rote learning in history (Lee et al., 2007). In addition, students adopting a deep learning

approach are also believed to be more organised learners as they plan their own study program and take down their own notes (Malie & Akir, 2011). As such, deep approaches are often associated with high quality learning outcomes (Ellis et al., 2008), such as high levels of achievement (Chiu, 2011), as Balasooriya, Hughes and Toohey (2009) wrote "better retention, understanding and greater ability to use the information" (p. 290).

Conversely, a surface approach is driven by external motivation (Chiou & Liang, 2012) and centred on memorization and reproduction of information, "without seeking for further connections, meaning, or the implications of what is learned" (Gijbels et al., 2008, p. 432). In other words, it is characterised by remembering and repeating information by means of rote learning with minimum effort to meet requirements (Evans et al., 2003; Rodriguez & Cano, 2007). That is, they will not use "active problem-solving skills and thinking skills" in their study (Dogan, Atmaca & Yolcu, 2012, p. 266). In addition, learners who embrace a surface approach are prone to carry out only compulsory and essential tasks. For example, they would not participate in voluntary assessment activities, were not interested in online forums, preferred assessment methods that supported rote learning, and depended on lecturers' notes instead of attending lectures. In short, these students aimed only for the most basic approach to learning as they lacked "awareness about the real meaning and purpose of the learning tasks" (Almeida et al., 2011, p. 166).

Unlike students adopting deep learning approaches, students who use a surface approach lack the ability to change their learning approaches to suit the demands of their learning tasks (Almeida et al., 2011). These students are said to use surface approaches when studying for their examinations and throughout the entire course program (Almeida et al., 2011; Gijbels et al., 2008). Moreover, surface learners are more passive and focus on facts and details. Thus, there is no personal engagement in the learning activities (Ellis et al., 2008). Their purpose is to obtain a good qualification and do well in tests (Evans et al., 2003). The use of such an approach is therefore

related to lower quality outcomes, low achievement and low grades (Chiu, 2011; Rahman & Mokhtar, 2012).

Besides the two common approaches, Biggs' (1987) also identified an additional learning approach, which he called achieving (cited in Abhayawansa & Fonseca, 2010). Students with this approach work hard to obtain the best results and use various learning methods to help them achieve their goal (Dogan et al.; Ling, Ng & Leung, 2011). This approach is largely influenced by examinations (Almeida et al., 2011). Therefore, the ways in which the students learn is not fixed (Ling et al., 2011). It can "take place through either deep or surface processing", depending on the context (Dogan et al., 2012, p. 266). Examples of such learning methods include planning and organizing, effective note-taking, prioritising as well as seeking cues from teachers as to what is expected for assessments (Evans et al., 2003; Phan, 2008; Zhang & Sternberg, 2000).

Each approach comprises both "motive and strategy" (Zhang & Sternberg, 2000, p. 470). Motive refers to the incentive for learning, while strategy refers to how one approaches learning (Zhang & Sternberg, 2000; Chiou & Liang, 2012). Students' motives for learning, that is, what the students hope to achieve, are believed to have an effect on how they approach learning (Evans et al., 2003). For example, students who have little interest in learning and only want to pass their examination with the least amount of effort will adopt a surface approach, such as rote learning. In contrast, students who are intrinsically motivated and interested in learning will adopt deep learning approaches, such as understanding the meaning of the nature of the problem or subjects (Watkins & Akande, 1994). Chiou and Liang (2012) posited that individuals may embrace both deep and surface motives at the same time and the "weighting between these two motives is task-dependent" (p. 85). In other words, students may hold a deep motive but embrace a surface approach to handle or manage a learning task in accordance with task requirements.

2.4.1 Learning approaches preferred by learners from different domains of study

To explore the probable factors that may influence one's learning approaches, it is necessary to first examine the various approaches preferred by each individual. These findings may be useful to inform educators about the desirable learning approaches they could employ in order to improve their teaching approaches and to help students achieve better grades.

Jarvis and Woodrow (2001) posited that students taking subjects from the Humanities and Social Sciences tended to work together and take a more active part in the classroom activities. Furthermore, these students were also more responsible and more likely to take charge of their own study, through group discussion and reading. On the other hand, students studying subjects, such as Mathematics and Science were less keen to ask their lecturers questions but they were generally interested in participating in class activities, for instance, taking part in presentations. These students were also believed to depend more on "external regulation" (p. 164) than students taking soft domains (that is, Sociology). In other words, they were unwilling to "look beyond their tutors and lecturers for explanations and information" (p. 164). Jarvis and Woodrow (2001) further suggested that students studying Humanities subjects were more inclined towards using the more interactive methods while those taking Mathematics and Science subjects were more likely to regard their lecturers as the authorities.

Wishart (2005) found similar findings, that is, undergraduates from the Information Science program favoured "talking and discussing" (p. 10) as their way of studying while students in the Computer Science program were more inclined to do and solve problems. Listening to explanation was the next preferred learning mode for these two groups of students. Although these days, students tend to increasingly rely on the internet for information, it was found that "reading journals and reading online" (p. 10) were the least preferred and unpopular learning approaches. In addition, it was also found that students from Computer Science prefer individual research while those from

the Information Sciences prefer seminar discussions. Practical workshops were the next preferred learning environment for these two groups of students.

Now that I have explained the various learning approaches and those preferred by learners from the different domains of study, I turn to explaining the possible factors affecting approaches to learning in the next sub-section.

2.4.2 Factors impacting approaches to learning

The adoption of one's learning approach is likely to be influenced by many factors (Malie & Akir, 2011). As reported by Kek and Huijser (2011), factors that might impact students' learning approaches include the variations in students' conceptions of learning, opinions about the assessments, perceptions of teaching and learning environments, as well as personal factors (such as gender, age, the years of education, disciplinary differences and motivation). In this section, I explore in detail the various factors that may influence students' learning approaches.

Richardson (2011) advocated that differences in students' perceptions, particularly the suitability of assessment and workload as well as the "amount of student choice" (p. 289), appeared to lead to differences in their learning approaches. In other words, how one approaches learning relies on how they perceive the content, the demands and context of the tasks (Almeida et al., 2011). For instance, if the workload is considered relatively heavy, students are more likely to adopt surface learning approaches. Likewise, if assessment is seen as focusing on the importance of memorizing rather than understanding, students are also more inclined to employ surface learning approaches and establish a surface motive, such as getting high marks and passing an examination (Chiou & Liang, 2012). Thus, there is a positive association between a surface learning approach and students' perceptions of heavy workload, as well as assessment methods that focus on memorization (Rahman & Mokhtar, 2012).

Other learning environment factors, such as "good teaching, vocational relevance and social climate" (p. 342), as well as clear goals, also influence how students learn (Karagiannopoulou & Christodoulides, 2005). For example, if students see these factors as positive, they are more likely to use deep approaches (Gijbels et al., 2008). These studies demonstrated that students with higher level conceptions of learning, such as applying and understanding, may move away from rote memorization and employ a deeper approach and adopt a deeper motive for learning, than those who embrace lower level conceptions. Thus, it is important to help students develop more sophisticated conceptions of learning (Almeida et al., 2011; Chiou & Liang, 2012). In brief, if the learning objectives, teaching approaches and assessment methods are designed in consideration of this literature, the use of deep approaches will hopefully increase while the adoption of surface approaches will decline (Rodriguez & Cano, 2007).

Age can be another determinant of approaches to learning. Researchers believed that as students grow older and as they progress in their studies, they are more likely to use deep level approaches and less surface approaches (Liang et al., 2010; Rodriguez & Cano, 2007; Zhang & Sternberg, 2000). Although it cannot be confirmed that the relationship is caused by "intellectual maturation" or a transformation in the school's teaching methods (Rodriguez & Cano, 2007, p. 650), it was generally believed that students who are adjusting to new learning environments and new demands, such as "heavy curriculum, work pressures" (p. 650), are more likely to use surface approaches. These findings are consistent with Minasian-Batmanian, Lingard and Prosser's (2006) study which revealed that students with "cohesive conceptions" (p. 1889) intended to adopt surface approaches when they were faced with ambiguity in a learning environment. After the students adjusted to the new environment, their learning moved towards a greater focus on "meaning and conceptual understanding" (Rodriguez & Cano, 2007, p. 650). Therefore, it is possible that the same student adjusts their learning approaches in different contexts (Minasian-Batmanian et al., 2006). As stated by Yang and Tsai (2010b), students who embrace cohesive conceptions have greater

understanding of the relationship between the learning environment and student learning, than students with fragmented conceptions.

Previous investigation by Cano (2005) found that students' academic-orientations have an effect on the adoption of one's learning approaches. That is, students who are task-oriented are more inclined to use deep learning than those whose academic-orientations are performance-oriented. As suggested by Cano (2005), task-orientation is associated with a "deep approach, persistence and academic success" (p. 215), while performance-orientation is connected to surface learning and poor performance.

In addition, studies which examined the influence of personal factors (such as family context and personality traits), as well as situational factors (for instance, classroom teaching and learning environment) on students' approaches to learning, found that both parental involvement and parents' educational achievement have an effect on students' use of learning approaches (Biggs, 1987; Kek, Darmawan & Chen, 2007; Kek & Huijser, 2011; Marjoribanks, 1996). That is, the more involved parents are in their children's studies and the more education the parents have, the more likely the students are to employ deep approaches. However, Kek et al. (2007) and Kek and Huijser (2011) also found that deep learning approaches were directly influenced by parents with low educational levels, such as only completing primary education. These parents were found to be actively and positively involved in supporting their children's study, inspiring them to not only be self-directed learners but also indirectly influencing them to employ deeper approaches to learning. In other words, parental involvement has a positive impact on the students' learning approaches and learning outcomes regardless of parental educational background (Marjoribanks, 1996). Thus, family context has revealed important predictors of students' approaches to learning (Kek et al., 2007).

Besides family environment, teaching approaches also play an important role in influencing students to adopt deep approaches to learning (Kember & Gow, 1994; Leung, Lu, Chen & Lu,

2008; Sheppard & Gilbert, 1991). Streitwieser and Light (2010) reported that "transmission" teaching approaches are associated with surface approaches to learning, while teaching approaches that emphasize the development of "conceptual change" (p. 347) are related to deep approaches. For example, classrooms which are regarded as high in personalization are linked to "the use of investigative skills and strategies" and this is said to have an effect on the adoption of deep approaches (Dart et al., 2000, p. 267). Therefore, the impact of an effective constructivist environment on the adoption of students' learning approaches is significant. Examples of a constructivist environment include constructivist-oriented pedagogies, such as collaboration, co-construction of information, self-regulated learning and authentic learning experiences (Evans & Kozhevnikova, 2011).

After determining the influence of the various factors on one's learning approaches, I now turn to discussing the relationships amongst students' use of ICT and the different aspects of learning, for instance their beliefs about, and approaches to learning.

2.5 The connection between students' use of technology and their epistemological beliefs, learning conceptions, and approaches to learning

The above literature review has explored the nature of Polytechnic students' uses of technology, as well as literature about student's epistemological beliefs, learning conceptions, as well as changes that their approaches to studying may undergo as the students advance through their study. Research has also found significant relationships between these different constructs and bodies of literature (Chai et al., 2009a, 2009b; Chan & Elliott, 2004; Richardson, 2010; Walker et al., 2009). For this reason, the influence of students' use of technology on their epistemological beliefs, learning conceptions and learning approaches will be examined in this section.

It was stated earlier in sub-section 2.1.1 that the selection of technology for social and academic uses is not "direct responses to technologies that are universally available" (Jones &

Healing, 2010, p. 351), rather their choices are more likely to reflect "highly contextualized purposes" (Bennett & Maton, 2010, p. 324) and to the specific requirements of their programs of study (Jones & Healing, 2010). This, therefore, suggests that students are "discerning users of new technologies, wanting to see clear educational or social value in using technologies" (Waycott et al., 2010, p. 1203). According to Deng et al. (2014), Ertmer (2005) as well as Kek and Huijser (2011), one's learning preferences, in terms of using technology to support learning, might be influenced by various factors, such as one's epistemological beliefs, conceptions of learning and ICT self-efficacy.

As discussed in sub-sections 2.2.3 and 2.3.3, individuals with naïve epistemological beliefs and reproductive conceptions of learning, have a tendency to adopt surface learning approaches like memorization and recalling facts. As such, they are more likely to use technologies in a traditional way (such as to access and memorise information and for drill and practice to support their acquisition of simple knowledge) and may be less likely to use technologies for collaborative, explorative learning as they tend to view group work and discussions as "unproductive" (p. 1030) and not beneficial to one's learning (Braten & Stromso, 2006). As we have seen, students who embrace the belief that knowledge is simple in structure, also tend to engage less in critical evaluation, use more superficial learning approaches and depend on authorities for their own learning (Chang, 2005; Davis, 1997; Ravert & Evans, 2007; Tolhurst, 2007). In addition, they also do not see the importance of seeking additional sources of information to evaluate the accuracy of the information they found on the internet. Thus, learners with such naïve epistemological beliefs might be less likely to use technology to access and critically compare multiple sources of information and construct knowledge and may be more likely to use technology to uncritically access what they perceive to be established, discrete facts. That is, students with naïve epistemological beliefs may not approach learning with technology in the active, critical way

sometimes thought to be typical of the Net Generation (Kennedy et al., 2007; McLoughlin & Lee, 2008; Williams & Chinn, 2009; Greenhow et al., 2009; Lambert & Cuper, 2008).

On the other hand, individuals with more sophisticated epistemological beliefs and constructivist conceptions of learning may be more inclined towards using educational technology in critical, collaborative and creative ways. They may be more likely to use technologies to critically explore information in-depth, to facilitate their construction, rather than mere acquisition of knowledge (Cho et al., 2011; Loyens et al., 2008; Lublin, 2003; Ravert & Evans, 2007; Schommer & Walker, 1997; Tolhurst, 2007; Tsai & Chuang, 2005; Tu et al., 2008; Walker et al., 2009). For instance, when individuals view "learning as a social phenomenon" (Keskitalo, 2011, p. 135), where they work together with the other students to co-construct knowledge, it seems probable that they will use technology tools, which can support such learning, for similar purposes learning. Hence, technology-based learning environments may be more useful for learners with sophisticated beliefs about knowledge and learning than for those with less advanced epistemological beliefs and reproductive conceptions of learning (Tsai, 2004a, 2004b). That is, students with sophisticated epistemological beliefs and constructivist views of learning may benefit more and be more successful with these technology-based learning environments, which can support constructivist approaches to knowing and learning (Bendixen & Hartley, 2003; Tsai, 2004b). However, as explained earlier in the chapter, it is also possible that technology based learning environments may encourage all students, including those with more naïve epistemological beliefs and surface approaches to learning, to be more critical, creative and deep learners because the affordances of ICT may support such knowing and learning.

Sang, Valcke, Braak and Tondeur (2010) also argued that one's inclination to use technologies and participate in IT-related activities is positively associated with their technological self-efficacy. That is, students with a high level of ICT self-efficacy are more likely to use technology as they have higher levels of confidence when using ICT, than students with a low level

of ICT self-efficacy. ICT self-efficacy is the "measure of a user's confidence to use, understand and apply their computer knowledge and skills" (Callum & Jeffrey, 2013, p. 304). This is further supported by other studies which suggested that students who believe strongly in innate ability demonstrate a lack of confidence, which in turn deters them from attempting challenging tasks (Davis, 1997; Schommer-Aikins et al., 2003; Tolhurst, 2007). Such deterrence might lead students who believe in innate ability and with low ICT self-efficacy to have a higher preference for traditional instruction than digital learning environments.

In view of the above, technologies do not entirely influence how one thinks, feels and learns. One's beliefs and views about learning appeared to be influenced by different determinants, and this in turn impact how they approach learning. However, technology use may be another factor that is influenced by, or shape, student's beliefs about knowledge and conceptions of, and approaches to learning.

2.6 Summary

The literature review has examined learners (in terms of their IT skill levels, as well as their access to, and use of technologies), their epistemological beliefs, conceptions of, and approaches to learning. The factors impacting the three constructs are also discussed as it relates to this research that seeks to better understand if students' use of technology has an effect on these constructs. The review also covered the connection between students' use of technology and the various elements of students' epistemological beliefs and approaches to learning. The next chapter explains the research methods and techniques employed in this study, the recruitment strategies, the ethical considerations of the study as well as the data collection and analysis techniques used.

CHAPTER 3 METHODOLOGY AND RESEARCH DESIGN

This chapter introduces the research paradigm and the conceptual framework and also explains the research aims, methods and techniques employed in this study. The sampling of participants, the recruitment strategies and ethical considerations of the study are also discussed. This chapter also provides details of the data collection techniques (that is, the qualitative research methods, specifically semi-structured interviews) as well as the data analysis techniques (that is, the content analysis method). To warrant the rigor of the collected data, the chapter examines the validity and reliability of the procedure. I now turn to discussing each area in more detail.

3.1 Research paradigm

Gray (2009) argued that the world is construed through the "classification schemas of the mind" (p. 21). Johnson (2007) postulated that the "views of knowledge and reality are influenced by one's preconceived beliefs, ideas and experiences – and by the impact of race, class, gender and so on – which allows for multiple constructions of meaning depending upon the body one inhabits in any particular social and historical context" (p. 49). From this standpoint, there will be no "single unitary reality" (Krauss, 2005, p. 760) since everyone's experiences are different from each other. As such, reality is "value-based rather than factual" (Wignall, 1998, p. 2). An interpretivist approach to research is ideal for exploring such social relations and constructed meanings. As stated by Cohen and Crabtree (2006a, 2006b) and Wignall (1998), social relations and meanings are constructed based on people's interpretations of reality or "self-selected facts" (Wignall, 1998, p. 2). Therefore, there is no "objective reality" (Krauss, 2005, p. 760) but multifarious realities and multiple interpretations (Dash, 2005; Krauss, 2005).

In an attempt to explore students' use of technology and to understand the varied meanings attached to their beliefs and learning, which embroils the intricacies and values of people, a subjectivist-interpretivist approach and its associated methods were seen to be most suitable for my

study. Subjectivist-interpretivist is used to delineate "a perspective that acknowledges the social world as constructed reality – a product of human action and interactions and of the meanings that social actors attach to their experiences" (Wignall, 1998, p. 2). In interpretive studies, qualitative methods and analysis, such as interviews, which are said to be able to extract data that is wider and deeper in detail, were used as my research approach (Dash, 2005; Gray, 2009). The interaction between the respondents and me as researcher allowed the illumination of what the participants' epistemological beliefs and conceptions of learning were and how they approached learning, thus gaining deeper insights into the phenomena (Holden & Lynch, 2004). A subjectivist-interpretivist approach was used to yield rich and detailed description and explore the views, opinions and experiences of the research participants.

3.2 Conceptual framework

As stated earlier, this study aimed to examine how students' use of technology is related to their epistemological beliefs, conceptions of learning, and approaches to learning. This area of examination is important for numerous reasons. First, McLuhan (1962) postulated that media technology could influence how one thinks, feels and learns. Demirbilek (2014) further suggested that when a new technology is created, individuals will change and acclimatise to that technology. This technological determinist approach insists that individuals do not have the power of making choices as they are constrained by the technology and the purposes for which it is developed. While this deterministic approach has been critiqued elsewhere, it is still useful to consider as there are many people who do not think through their responses to technology. Some tend to accept and take up new practices with little consideration of their impact.

Other studies have revealed that one's inclination to use technologies and preference to take part in IT activities is positively related to their computer self-efficacy (Sang et al., 2010) and perceptions of technology usefulness (Callum & Jeffrey, 2013). That is, students will use

technology for learning if they a) develop a high level of ICT self-efficacy, b) perceive technologies as being easy to use, and c) are able to see the benefits provided by technologies in learning. Additionally, previous research also reported that students, who are frequent users of technology tools, may not necessarily prefer to use technology for learning (Brown & Czerniewicz, 2010; Kvavik & Caruso, 2005). This is congruent with Meagher's (2012) study which showed that while students might have developed their skills in using a particular technology, they might not view that technology to be appropriate for education or useful in learning. As stated in sub-section 2.5, one's learning preferences, in terms of using technology to support learning, could be influenced by one's epistemological beliefs (Deng et al., 2014; Ertmer, 2005).

Third, there is a body of evidence that students' epistemological beliefs affect their learning conceptions, which in turn influences their learning approaches (Brownlee et al., 2009; Cano, 2005; Liang et al., 2010; Schommer-Aikins et al., 2003; Walker et al., 2009; Zhu et al., 2008). For instance, a learner with naïve epistemological beliefs, who perceived learning as the "acquisition and accumulation of content" (Dart et al., 2000, p. 264), is more inclined to use a surface approach to learning, such as memorizing (Walker et al., 2009; Watkins & Akande, 1994). On the other hand, a learner who embraces sophisticated epistemological beliefs tends to believe that learning is a process of "understanding and meaning by relating and connecting new material to prior knowledge" (Dart et al., 2000, p. 264). These students are therefore more likely to adopt deep approaches (Watkins & Akande, 1994).

Fourth, earlier studies have established a direct relationship between learning conceptions and approaches to learning (Brownlee et al, 2009; Lee et al., 2007; Zhu et al., 2008). For example, a learner, who regards learning as "applying, understanding and seeing in a new way" (Lee et al., 2007, p. 213), is likely to use deep approaches to learning, such as constructive learning (Lee et al., 2007; Tsai, 2004a). In contrast, learners, who viewed learning as "testing and reproductive" (Lee et

al., 2007, p. 212) are more inclined to employ surface approaches, which is, “rote learning” (Lee et al., 2007, p. 196; Tsai, 2004b).

In addition, reviews of literature on beliefs about knowledge have also reported that there is direct association between students’ epistemological beliefs and their learning approaches (Phillips, 1998; Phan, 2008; Schommer-Aikins et al., 2003; Tolhurst, 2007). For example, students who viewed knowledge as certain and as handed down by experts, are more inclined to use a “rote strategy” (Liang et al., 2010, p. 55). Conversely, students who perceived knowledge as deriving from “reasoning, thinking and experimenting” (Liang et al., 2010, p. 55) are more likely to use deep approaches. In brief, learners with naïve beliefs have a preference for surface learning while learners with sophisticated beliefs prefer deep learning (Liang et al., 2010; Phan, 2008).

As discussed earlier, technologies not only have improved and transformed the learning environment but also influenced one’s beliefs and use of technologies (Hew & Brush, 2007; Kennedy & Fox, 2013; Waycott et al., 2010; Tapscott, 2009). Therefore, I expect that one’s epistemologies, learning conceptions and approaches to learning may be affected by their digitally mediated experiences and the digitally mediated environment. Additionally, it is widely assumed that young people today use technologies extensively for personal purposes, work and study (Brown & Czerniewicz, 2010). Previous studies also revealed that epistemological beliefs, conceptions about, and approaches to learning could be amongst the various factors that may have a significant impact on educational change (Gurcay et al., 2013; Lim & Chai, 2008). In view of this, the nature of students' use of technology for learning purposes and its relationship to their epistemological beliefs, conceptions of, and approaches to learning are worthy of examination as it would pave the way toward identifying and employing suitable and meaningful learning activities in the classroom.

3.3 Research design

This section presents the research aims as well as describing the research methods I used in this study. It also includes details about the sampling of participants, recruitment strategies and ethical considerations of the study.

3.3.1 Research questions

The research questions that informed this study are:

1. What is the extent and nature of post-secondary students' use of technology for learning?
2. What are the epistemological beliefs surrounding learning with technologies among the post-secondary students, their conceptions of, and approaches to learning?
3. How does the students' use of technology influence their beliefs about knowledge, conceptions of, and approaches to learning?

3.3.2 Research methods – Why qualitative methods?

Qualitative research is an "umbrella concept covering several forms of inquiry that help us understand and explain the meaning of social phenomena with as little disruption of the natural setting as possible" (Aydin, Boz & Boz, 2010, p. 257). As stated earlier, my research focuses on learners' experiences with technology and their conceptions of, and beliefs about learning, which are viewed by van Driel, Bulte and Verloop (2005) as being complex in nature.

The aim of this study is not to ascertain any absolute truth, but to elucidate the lived experiences of the participants; therefore qualitative research methods, specifically semi-structured interviews, are considered suitable for the following reasons. First, a qualitative research method is able to provide a more comprehensive understanding of human behaviour, motivations, values, opinions and emotions (Madrigal & McClain, 2012). As I am obtaining details about personality traits (such as IT skills, experiences with technology, and the frequency with which the technology

is used) from the perspective of the participants, as well as individuals' accounts of their learning experiences and their perceptions of ICT use in the classroom, the qualitative approach will be particularly useful in this study.

Second, the qualitative interview research method is "open and flexible" (Fidel, 1993, p. 226; Fraenkel & Wallen, 2006; Gay, Mills & Airasian, 2009), and not only allows me to interact closely with the participants (Fraenkel & Wallen, 2006; Krauss, 2005; Saveney & Robinson, 2004), but it also enables the participants to express their views, feelings and experiences more freely, thoroughly and in greater detail. Due to the candidness and flexibility of this approach, it provides me the opportunity to probe deeper into the responses of the participants in order to obtain more in-depth answers to questions. In addition, it also allows me to adjust and modify my subsequent questions accordingly based on the information provided by the participants (Madrigal & McClain, 2012). Qualitative interview research methods are, therefore, great tools for gaining a deeper understanding of the participants' experiences and their beliefs (Hoepfl, 1997).

Third, qualitative methods seek to examine things in their natural setting and maintain the intricacies of human behaviour (Greenhalgh & Taylor, 1997). Therefore, qualitative research reports are more meaningful as qualitative approach allows me to provide details of the situational context and the behaviours of the participants which may be affected by the context. McMillan (2004) postulated that context is important in providing an understanding of the phenomenon being examined and the accuracy of the data decreases if the setting is not taken into account. Finally, the use of such qualitative research in this study is consistent with qualitative researchers who are interested in "descriptive data to gain insights into the phenomena of interest" (Gay et al., 2009, p. 366; Fraenkel & Wallen, 2006).

To address the research questions in this study, a qualitative data collection technique, namely, semi-structured interviews, was utilised as it allowed me to access the in-depth views of a small number of research participants, while also enabling me to gain deep insights into various

social phenomena relevant to the research questions (Greenhalgh & Taylor, 1997). The process of data collection used will be explained in detail in sub-section 3.4.

3.3.3 Research participants

The research data for this study was acquired through individual interviews with twelve students. Of them, six students were freshmen (first year students) and six students were nearing the end of their third year of study. Previous studies showed that epistemological beliefs varied as the students advanced through school (Brownlee et al., 2009, p. 602; Walker et al., 2009) and that prior experience of learning had an impact on their beliefs about learning and their approaches to learning (Littlejohn et al., 2010; Margaryan et al., 2011). Thus, freshmen and third year students were chosen.

The School of InfoComm Technology was selected because the program was considered an applied discipline and students majoring in an applied discipline were likely to use more technology for learning (Margaryan et al, 2011). According to Littlejohn et al. (2010), students who had good technology skills were more likely to have a greater preference for using technology in the classroom. In addition, past research has found significant differences in technology use between the males and the females (Kennedy et al., 2010a, 2010b). As such, I requested both male students (4 males from Year 1 and Year 3 respectively) and female students (2 females from Year 1 and Year 3 respectively) to participate in my research study.

3.3.4 Recruitment strategies and ethical considerations

After I obtained permission from the Monash University Human Research Ethics Committee (MUHREC) in May 2012 [Project Number: CF12/0695 - 2012000299], I wrote to the Director of School of InfoComm Technology requesting permission to conduct my Ph.D. study at the school. The information which included my research proposal, research benefits, estimated duration and

procedures for data collection and the recruitment of participants, as well as my contact details and the contact details of my supervisor were clearly stated in the email (shown in Appendix A). I received an approval email from the school one week later. Subsequently, I wrote to the school administrator to seek her help in putting up posters to recruit research participants on the school noticeboards (attached in Appendix B).

Initially, only posters were used to recruit participants. However, there was no response from the students despite the posters being placed on the electronic noticeboards for a month and despite the lecturers drawing their students' attention to the posters. Thus, an initial concern raised by the school administrator was true. When I first approached the school to help me in putting up my posters on their noticeboards, the first question the administrator asked was whether I needed help in recruiting students as she was aware that their students could be rather passive for such activities, unless they were chosen by the school. Despite the advice, I still went ahead with the poster as the recruitment method, thinking that some students might be interested to participate. As the timeline for my announcement was expiring and there was still no response, I re-approached the school administrator to put the posters on the normal noticeboards in addition to the electronic noticeboards, hoping that students would read the hard copy version of the posters instead. However, she predicted that the response would be the same unless the students were picked by the school. The administrator went on to share the school's experiences with me, that is, the school had to "drag" their students to participate in various surveys/interviews. Hence, the school administrator kindly suggested to me that she would randomly identify and recommend some students on my behalf. Since the administrator was not the students' lecturer and the identification process was random, I believed that the participants were not in any way coerced into the participation of the study. At the same time, I also altered my recruitment method and prepared a copy of the amendment form to be re-submitted to MUHREC. The amendment was approved in July 2012.

Based on my requests, that is, the participants must be first year students who had just enrolled into the school and students nearing the end of their third year study, the school administrator then randomly identified and selected the participants from the students' database. A total of twenty-four students were selected.

The school administrator gave my contact details to the participants. Out of the twenty-four students, only twelve students (six first year students and six final year students) contacted me, expressing their interest in participating. I interviewed all of them as there were no other students from which to select. When the students called me, I obtained verbal consent from them before confirming their level of study (that is whether they were first year or third year students) and technology skills. The participants were required to be adept at using technology, if not they should at least possess some skills in using core technologies for learning purposes, such as learning management system and library websites. This was because a previous study showed that students who had good technology skills were more likely to have higher preference for use of technologies in the classroom (Littlejohn et al., 2010). This is aligned with my research focus which aims to understand how learners' use of technologies influences their epistemological beliefs, conceptions of, and approaches to learning.

Prior to meeting the students, a friendly email to introduce myself (presented in Appendix Ci and Cii) and an Explanatory Statement were sent to both Year 1 and Year 3 students. Upon receipt of their consent for an informal meet up session, I made a mutually convenient time for our first physical meeting to give out the consent form, written in English, and run through the information on the Explanatory Statement with the students. The information, which included an explanation of the purpose for the research, an estimated duration of the interview and procedures for conducting the interview, as well as their right to reject or withdraw from the study at any time, were clearly stated on the consent agreement. In addition, permission to record their interviews was also sought in the same consent form. As Fraenkel and Wallen (2006) stated, "researchers should never lie to

subjects nor record any conservations using a hidden tape recorder" (p. 441). The process from giving the participants my contact details, to the students contacting me and arranging for an interview session took about a month.

3.4 Data collection methods

This study was established in two phases – the first stage was the literature review that developed the background to the research, while the second was the data collection which used a qualitative approach. Some researchers claim that the best approach to explore participants' views, opinions and experiences is the use of interviews (Bennett, Maton, & Kervin, 2008; Gray, 2009). According to Gray (2009), "interviewing is a powerful way of helping people to make explicit things that have hitherto been implicit – to articulate their tacit perceptions, feelings and understandings" (p. 370). Therefore, in this study, the qualitative data collection methods employed me (the researcher) as the data collection tool, which included interviews and the researcher's research journal. As stated by Yin (1994), various sources of evidence could be used to improve the overall validity of this set of data. I will describe each of these methods in turn.

3.4.1 Interviews

The aim of this study is to explain and uncover how participants used technologies, and the relationships which were exemplified within the conceptual framework that is, the relationships amongst the various aspects of learning, such as the beliefs about learning and their approaches to studying. In order to gain deeper insights into these relationships, interview techniques were used as they afforded an opportunity for me to clarify as I encountered new findings, as well as provided me flexibility to change the order of the predetermined questions. Interviews enabled the participants to share their opinions, feelings, experiences and perceptions in their own words, thus allowing me

access to their thoughts in their own terms, rather than using words that I may have proposed (Patton, 2002).

Semi-structured interviews, are a research technique commonly used to examine epistemological beliefs (for example, Belenky et al., 1986; Marra, 2005). To delimit the areas to be explored, several key questions were asked during the interviews (Gill, Stewart, Treasure & Chadwick, 2008). The interviews were rather informal and had a conversational feel to some degree. This was because from time to time, as the dialogue with the participants developed, I would ask questions that were not on the list, or the questions could be asked in different sequence. Sometimes, depending on the situation, I might not ask all the predetermined questions. For instance, on some occasions where the responses from participants had fully addressed my question or the participants had shared more than what was required in their initial responses, I would not repeat asking them the same question. The first objective in using semi-structured interviews was to provide me and the participants with some guidance on what to ask and share respectively. In addition, the use of semi-structured interviews not only enabled me to probe for more detailed answers to the initial responses of the participants but also helped me to discover information that might not have initially been thought of as relevant but which was later found to be significant to the participants (Gill et al., 2008; Gray, 2009), hence providing a better understanding of the phenomenon under investigation.

During the interviews, I employed open-ended questions because such a question format not only allowed the opportunity for a full and meaningful discussion, but it also enabled the participants to have a voice within the context of this research study, that is, the participants were able to "respond in their own words without feeling inadequate to the task" (Johnson, 2007, p. 78). In other words, open-ended questions enabled the participants to answer how he/she desired. This, therefore, reduced the influence of the interviewer on the beliefs, views and words of the participants.

3.4.1.1 Designing interview questions

Different scenarios were used as stimulants to prompt discussion. As many students might have difficulty understanding what epistemological beliefs are or what learning is about, it was vital to design interview questions so that abstract concepts (like epistemological beliefs and other learning related topics such as conceptions of, and approaches to learning) could be understood by the students. Therefore, scenario-based interviews, also adopted by Brownlee et al. (2009), were used for my study (as seen in Appendix D) in order to provide examples of these concepts in practice.

For this study, three scenarios depicting typical learning experiences that might be encountered by students were used so that the participants could relate to them better (Brownlee et al., 2009). The first scenario described a teacher's beliefs and her teaching approaches; the second scenario depicted how the teacher used technology in the classroom, while the last scenario illustrated students' views on their teacher's teaching method. The first and second scenarios aimed to find out about learning and the use of technology in the classroom from the participants' perspectives while the last scenario aimed to determine how they would approach learning. I now turn to discuss in more detail how the literature review has influenced the questions I asked.

The interview questions were crafted from a review of relevant literature, as discussed in chapter 2. As mentioned earlier in section 2.3, one's beliefs about knowledge could bring about particular beliefs about learning and how students approached learning. To explore the relationships among the different aspects of learning and to promote constructivist learning experiences of the learners so as to facilitate the development of more sophisticated beliefs in students, a range of questions were asked during the interview. For instance, the participants' beliefs about knowledge were elicited by asking the following questions:

- *Ms Jennie Walker feels that understanding, such as knowing how the formula is derived, is not essential. She also confines her instruction to drill and practice. There is no*

collaboration activities and students work individually. Do you think that this was the right action by the lecturer in this situation? Why? What would you do?

- *Professor Warren Esty, a Professor of Mathematics at Montana State University and Assistant Professor, Norah Esty, of Mathematics at University of California Berkeley believed that Mathematics is like a sport. Even the best player, must practice a lot to get good. Could the experts' beliefs be incorrect? Do you trust the views of experts?*

- *What do you think of Ms Walker's teaching method, that is, students needed to get more practices with Mathematics in order to excel?*

On the other hand, the beliefs about learning were measured by asking questions, such as,

- *From time to time people talk about collaborative learning and/or scenario-based learning. What do know about these approaches? What benefits do these teaching methods bring to learning? What are your views?*

- *What is good learning?*

- *What do you think is more important in a learning process?*

- *How do you know when you have learnt something?*

These interview questions were devised using Hofer's (2004) epistemological framework regarding "the nature of knowledge (what one believes knowledge is) and the nature of knowing (how one comes to know)" (Hofer, 2004, p. 46).

Earlier, in sub-section 2.1.1, it was noted that students are "discerning users of new technologies, wanting to see clear educational or social value in using technologies", rather than incorporating technologies in the classroom for technology's sake (Waycott et al., 2010, p. 1203). To find out how the participants viewed the use of technology in the classroom, they were asked a set of questions, as follows,

- *Ms Walker uses technology for presentation and for attendance marking and communications. What are your views on Ms Walker's use of technology?*

- *In what way does technology help to improve teaching and learning? Can you give me an example of how it has improved your learning in school?*

- *Can you give me an example of how technology has helped you to learn?*

- *What do you believe is good teaching practice in tertiary education?*

Prior studies on the beliefs about knowledge have reported that there is a direct association between students' epistemological beliefs and their learning approaches (Phillips, 1998; Phan, 2008; Schommer-Aikins et al., 2003; Tolhurst, 2007). Therefore, to have in-depth understanding of the relationship amongst the various aspects of learning and to encourage deep learning approaches, it is essential to find out the learning approaches adopted by the study participants. To evaluate the learning approaches adopted by the research participants, the following questions were asked:

- *How do you think you learn best?*
- *What are your preferred ways of learning?*
- *Can you tell me how you go about learning in various situations, that is,*
  a) *What do you do if you have difficulty with the topic or if you are preparing your weakest subject? What strategies would you use to help you understand the topic being taught in class?*
  b) *If the assignment grade contributes significantly to your final semester grade, what strategies would you use to help you plan and do the assignment?*

All the interview questions were reviewed, attuned and agreed by the researcher's supervisors before submitting to the Research Ethics Committee at Monash University for approval.

3.4.1.2 Interview process and ethical considerations

In this study, the research data were obtained by interviewing twelve randomly identified students. The interviews were undertaken in a semi-structured way and were audio-recorded with the permission of the students.

Prior to the interview, a list of questions was sent to the participants. This allowed the participants to run through the questions and prepare the answers in advance if they wished. In addition, this gave them a heads up on what the interview was about. Every participant was interviewed individually by me. It is possible that the students might feel intimidated, especially if

they considered me as someone in a position of authority. Therefore, I endeavoured to dress casually, for instance, I wore jeans, t-shirts and light make-up. Furthermore, I tried to learn from my younger colleagues some language commonly used by the Net Generation, so that I could better understand their language and communicate with the participants (Fraenkel & Wallen, 2006). This demonstrates my commitment and effort to make the interview atmosphere less tense.

Before the interview commenced, I stated and restated that a) they were under no pressure to take part in this interview, and b) they had a choice to choose what questions to answer (and this included those questions that were asked on the spot). I also assured them that there were no right or wrong answers. In my commitment to ethical research, I believed I had adequately reassured the participants that their participation was optional and voluntary. I did not intimidate or compel any of the participants to participate because all the identified participants contacted me. As they contacted me, it showed that they would like to be involved in the study. Furthermore, I also gained informed consent from all the participants before proceeding with the interviews.

The participants were also informed that in the reporting of the findings of this study, their identities would be kept confidential through the use of pseudonyms. This is to protect them from humiliation or detriment (Fraenkel & Wallen, 2006). As such, I made an effort not to include any details in this thesis that might be able to identify them. All recorded interviews, transcripts and observation notes were only be accessible by my supervisors and me. Participants were informed that the findings of my study would be purely used for this doctoral thesis and the recorded audio will be used for transcripts and analysis purpose. Before and during the interview, I re-emphasized to the participants that it was not compulsory for them to answer all the questions. That is, they did not have to answer any of the questions if they did not wish to, including the impromptu questions that were asked during the interview. All twelve interviews were conducted throughout the months of August, 2012 – February, 2013.

As it was our first meeting, both the participants and I were feeling nervous. To reduce the tension and to get the discussion started, I began the interview session with questions that the participants could answer easily. As mentioned by Gill et al. (2008), this can help to build the confidence level of the participants, make them feel more comfortable, and also establish rapport between me (as the researcher) and the participants. Furthermore, it is also believed that such an approach can generate rich data and consequently help the interview to progress further. For example, some general and simple questions being asked included the students' background, perceptions of their own IT experiences (for example, how they use technology in their social life and schools, their frequency of use of technologies and their prior and current learning experiences) and their learning choice or preferred ways of learning. The interview questions, which were adapted from Littlejohn et al. (2010), are illustrated below:

Present situation

1. *How would you define yourself in regard to your ICT usage? A basic user? An average user? An advanced user? Can you give me an example of your IT skills?*
2. *How do you use digital technologies (e.g. smart phones, notebooks and video games) and technology tools (e.g. social networking sites, wikis and podcasts)? Do you use them more for personal or educational purposes? What types of activities do you usually engage in?*
3. *How often do you use technology for personal purposes - every day, most days, once per week, once per month, less than once per month?*
4. *How often do you use technology for academic purposes - every day, most days, once per week, once per month, less than once per month?*
5. *How long do you spend on the computer during school term? How many hours do you spend each day? Will you spend more hours during school holidays?*
6. *How does technology affect your everyday life? Can you give an example?*
7. *Are most of your friends (apart from your classmates) as IT savvy as you?*
8. *Why did you choose InfoComm Technology?*

Past - before you come to the Polytechnic

1. *How did you learn before coming to the Polytechnic?*

   (a) Were you introduced to technology during your secondary school days? If yes, kindly give an example of how technology was used in your secondary school?

   (b) How often did your secondary school teacher use technology in the classroom?

2. *How often did you use technology - every day, most days, once per week, once per month, less than once per month?*

   (a) In what ways did you use digital technologies (e.g. smart phones, notebooks and video games) and technology tools (e.g. social networking sites, wikis and podcasts)?

   (b) Did you use them more for personal or educational purposes?

3. *What were your preferred ways of learning before coming to the Polytechnic?*

In addition to the above general questions, the interview questions encompassed three other major parts, namely students' beliefs about knowledge and knowing; students' conceptions about, and approaches to learning, as well as factors affecting epistemological beliefs. The scenarios and accompanying questions (also referred to in sub-section 3.4.1.2) are presented in Appendix D respectively.

As Gray (2009) pointed out, "whether an interview is successful in eliciting the range and depth of answers required will depend in large part on the skills of the interviewer" (p. 371). Being a practitioner-researcher, it was important that I prepared a list of open-ended questions for the interview so that key information would not be left out but would be obtained from each participant. As such, the interviews were guided by a set of questions and they were used for both groups of participants. Although all the participants were asked the same set of key questions, the sequence of the questions and the exact words used, as well as the kind of impromptu questions (to seek clarification from the participants) differed. As mentioned earlier, all the participants were feeling nervous, but there were a few who were particularly nervous. As such, they were initially not willing to share their views and experiences with me. I had to ask many different questions before

they would share more information with me. I also found that constantly reassuring the participants (for example maintaining a friendly and affirming manner such as smiling to them and saying short phrases like "Yes") helped to reduce the level of tension. After a short time talking with them, they began to gradually open up, that is, to be able to talk more freely and without inhibition. Therefore, I found that it is very important to establish good rapport with the participants because if they do not trust the researcher, they will not be willing to describe their true feelings and views (Shenton, 2004a).

During the interview, the participants were asked to read the scenarios, which were given to them one at a time. After reading each scenario, I asked questions related to the content. The participants were encouraged to share their thoughts and feelings spontaneously. If the participants could not understand a question or seemed to be very quiet during the interview or if I could not understand what the participants were saying, I would ask additional questions (Gay et al., 2009) or "ask the same question but in different ways" (Fraenkel & Wallen, 2006, p. 459). This helped to elicit responses and gain a better understanding. During the interviews, I was cautious with what I asked as I was aware that my questions might influence the participants' answers, or put 'words in their mouth'. In addition, to avoid the use of jargon or overly technical terminology, the interview questions were phrased in such a way that it was easier for the participants to understand them, for instance, "Do you trust the views of experts?"; "How do you think students learn best?" The interview questions are included in Appendix D. During the interview, I also paid attention to what the participants said so that I could quickly follow-up with the right questions if I needed further clarifications.

Each interview was conducted during the teaching semester, at a mutually convenient time in a meeting room in the Polytechnic, and lasted approximately 60 – 90 minutes. None of the interviews were rushed. The verbatim transcripts of these interviews were the main source for examining the students' beliefs about knowledge and knowing, students' conceptions of learning

and students' approaches to learning. At the end of the interview, I thanked the participants for their time and participation (Gill et al., 2008) and reassured them that the findings of the research were mainly to be documented in this thesis. They were informed that if they were interested in the results of this study, I would send the results to them upon conclusion of the project.

3.4.2 Research journal

I am an instructional designer and also a manager of a courseware development department. As an instructional designer, it is my responsibility to design effective learning experiences for the students. The learning experiences here refer to students' learning strategies, learning environment and curriculum materials. In order to create a learning environment that effectively fosters deep learning, it is essential to study Net Generation students (for example, their IT skills and learning preferences) so as to determine the appropriate instructional needs.

Being a staff member of the Polytechnic and conducting a study on issues related to my current work, there is likelihood for personal bias at each phase of design, data collection and analysis. As such, I tried to embrace a "theoretical sensitivity" stance (Gray, 2009; Hoepfl, 1997) when conducting my research. According to Hoepfl (1997),

> [T]heoretical sensitivity refers to a personal quality of the researcher. It indicates an awareness of the subtleties of meaning of data. … [It] refers to the attribute of having insight, the ability to give meaning to data, the capacity to understand, and capability to separate the pertinent from that which isn't. (p. 50)

In other words, I needed to understand and distinguish between what was essential and important information for inclusion and what was not.

Since there might be bias through the influence of my belief systems and working experience, it is therefore important that when I carried out the interview, I needed to be sensitive and alert so as not to let my preconceptions affect the answers given by my participants or the

interpretation of my findings which might be skewed towards what I hoped to achieve. To prevent myself from being affected by my biased perceptions, I used a journal to record how I interacted with the participants and what glitches I encountered during the interview. By writing down my thoughts and observations, it helped to validate my approaches, and it also helped me identify and assess any possible problems and/or issues. The use of a reflective approach enabled me to be more observant and mindful of the "cultural, political, social, linguistic, and ideological origins of one's own perspective and voices of those one interviews and those to whom one reports" (Patton, 2002, p. 65), thus allowing me to address any inconsistencies that might arise during the data collection and analysis stages. I, therefore, believed that the use of reflection actually heightened the credibility of the text. Below are three excerpts from my journal demonstrating my thoughts and observations:

- *Today was my first interview session. I was excited and at the same time nervous about meeting the interviewees – a reminder to keep myself calm and look composed in front of the students because my mood could influence the students [Excerpt from research journal, 17/08/2012]*.
- *Met Charles today. As he was very nervous, it was very difficult for me to obtain rich data from him, because he kept giving short phrase replies and I had to keep prompting him with questions. I became nervous too because I need to come up with more impromptu questions - (1) To prepare more questions for the subsequent interview sessions in case there were more of such students, (2) to move the general questions to the front, so as to break the ice between the participant and the interviewer [Excerpt from research journal, 21/08/2012]*.
- *After several rounds of interviews, I was surprised to find out from the participants (whom I had interviewed so far) that they actually preferred teacher-centred learning. When I asked them "How technology has helped them learnt?", all the participants replied that they used it for visualization purposes, and communication or accessing information. None actually*

used technology for collaborative learning. I was aware that I might influence the participants' responses, therefore during the interviews, I was careful with what I asked, listened attentively and keeping a clear conscious mind so as not to use any leading hints or prompts that might affect the accuracy of the data.

I believed such observations and the use of research journal not only helped to reflect on and also enhance the process of the interviews, but they also served as a useful reminder for me. For example, it allowed me to evaluate honestly what I had learnt about (i) myself and (ii) the project. These included:

- Reminding myself to always maintain a friendly and patient manner throughout the interview session so as not make the participants feel intimidated by the environment or me
- Reflecting on my language and the tone I used, so that I could adapt according to each individual participant's attitudes to ensure that they would not feel intimidated and that accurate data could be acquired
- The appropriateness of the pre-defined questions and probes and whether they should be modified to obtain deeper data

As I was directly involved in the design of the interview questions, the interview process and also the analysis of data, it was essential to constantly remind myself of any potential personal bias (through the influence of my belief systems and working experience) that might arise during the research study and if in doubt, continuously seek further explanation from the participants rather than making assumptions.

3.5 Data analysis methods

According to Gay et al. (2009), data analysis, which encompasses "summarizing what's in the data" (p. 448), is one of the necessary steps in the research practice. In a qualitative research

design, everything is in a dynamic state. Hence, it was impossible to predict the types of data that I would get from my interviews with the participants. Due to the volatility of the data, I had to be receptive to different and new insights which I might get from the participants. To analyse the data, content analysis was employed. Results from the content analysis are presented thematically in the findings chapter, supported with examples of interview excerpts to demonstrate the points I wish to illustrate. Through the use of semi-structured interviews and a research journal, I aimed to document each participant's attributes and their IT skill levels, their epistemological beliefs, conceptions of, and approaches to learning.

3.5.1 Research journal

As Svensson (1997) suggested, not everything that was shared during an interview would be appropriate and useful. Therefore, to obtain critical data and avoid collecting data that might not be relevant to the study, I continuously reflected on my data collection techniques and research questions to ensure that the data acquired was important and suitable to my research findings (Gay et al., 2009). This was done by reflecting on and recording the processes of my reflection, my thoughts and observations in a research journal, as mentioned earlier in sub-section 3.4.2.

Having a research journal not only enabled me to draw attention to any restrictions or limitations in the study, but it also provided the opportunity for me to have a voice within my write-up. The journal also allowed me to countercheck that all data was interpreted accurately. Considering the above, the research journal helped to maintain the accuracy and quality of data.

The following sub-section described what I actually did to analyse the data.

3.5.2 Content analysis

As stated earlier, the purpose of this research study was to examine how the Polytechnic students' use of technology influenced their epistemological beliefs, conceptions of, and approaches

to learning. In the following paragraphs, each of the various stages of the content analysis method used to analyse the transcribed data is discussed in detail.

3.5.2.1 The process of qualitative content analysis

The interviews were analysed using Braun and Clarke's (2006) six stages of thematic analysis:

Stage 1: Familiarization with data

As soon as the interview was conducted, the participants' responses were manually transcribed word for word using Microsoft Word software. As advocated by Shenton (2004b), Microsoft Word has features that allow a researcher to search for terms within the document and to copy relevant excerpts from a transcript to a report accurately. I did not use any software program for conducting qualitative data analysis because I felt that if I were able to do it myself, I would be able to understand the interviewees' responses better and be familiar with the data as I had the opportunity to read and re-read the transcripts multiple times (Shenton, 2004b). After the responses were transcribed, I read the completed transcripts to obtain a general sense of the data. Then for each interview transcript, I identified, highlighted and/or underlined all instances that seemed to denote a particular phenomenon, such as, their use of technology, their beliefs about learning, conceptions of, and approaches to learning. To ensure that all the possible occurrences of a situation are captured, it is essential to highlight or underline the text before commencing coding as "identified text without coding might increase trustworthiness" (Hsieh & Shannon, 2005, p. 1282). The following shows a fragment of two transcripts:

i) Titus' transcript

Researcher: Do you trust the views of experts?

Titus: Yes, because they are quite senior in their field. They are not only able to understand concepts but they can also teach. Therefore, they definitely know a lot about their own subject and I

believe that what they do is right.

Researcher: You feel that your lecturers know what is best for the students and you trust the views of your lecturers and mentors. If they think that certain things are good for the students, you will follow them.

Titus: Yes.

Researcher: In Ms Walker's class, students work individually and there is no collaboration activities. Do you think that this should be the right way of teaching?

Titus: No definitely not because some students are stronger while some are weaker. If you put them together, they can probably learn more from each other. They can learn each other's mistakes and each other's strengths.

ii) Warren's transcript

Researcher: Do you trust the views of experts?

Warren: Yes, I trust their views because it is quite true for Mathematics where you need to practice and practice. The more you do the more you understand. Whatever he says apply to the subject but not so much on other subjects. It depends a lot on the subjects.

Researcher: You agree with the Professors because these two Professors are talking about Mathematics, which you think one needs to have lots of practices. But you feel that this may not be true in other subjects.

Warren: Yes.

Researcher: In Ms Walker's class, students work individually and there is no collaboration activities. Do you think that this should be the right way of teaching?

Warren: In collaborative learning, you can ask one another. Whether you can learn faster, it depends on the group you work with. If they are all capable students, then you will gain more knowledge than if you work by yourself.

Stages 2 and 3: Initial code generation and themes searching

After familiarizing myself with the data, I began to code all highlighted/underlined text and formulate a preliminary coding scheme, using existing or earlier research studies. The findings were coded based on the research questions (Miles & Huberman, 1994). During the process, I coded and re-coded the same data to ensure consistencies of the results (Anney, 2014) and also to avoid "drifting into an idiosyncratic sense of what the codes mean" (Schilling, 2006, p. 33; Zhang &

Wildemuth, 2009). Doing so helped me to gain a deeper understanding of the data patterns. Preliminary codes that exemplified students' use of technology, their beliefs about knowledge and learning as well as their learning methods were identified and marked on the interview transcripts. This was followed by identifying emerging themes. The following are two examples:

a) Generating initial codes

i. Titus' transcript

Transcript	Initial Codes
Yes, because they are quite senior in their field. They are not only able to understand concepts but they can also teach. Therefore, they definitely know a lot about their own subject and I believe that what they do is right.	• Senior in the subject matter • Can understand concepts • Can teach • Know a lot about their own subject • Believe in them
No definitely not because some students are stronger while some are weaker. If you put them together, they can probably learn more from each other. They can learn each other's mistakes and each other's strengths.	• Appear to believe that the learning was innate to some degree • Does not seem to believe that effort and success were related with more learning

ii. Warren's transcript

Transcript	Initial Codes
Yes, I trust their views because it is quite true for Mathematics where you need to practice and practice. The more you do the more you understand. Whatever he says apply to the subject but not so much on other subjects. It depends a lot on the subjects.	• Trust experts' views • True for Mathematics where one needs repetitive practice • The more you do the more you understand • Whatever the expert says applies to the subject, not so much on other subjects • Depends a lot on the subjects
In collaborative learning, you can ask one another. Whether you can learn faster, it depends on the group you work with. If they are all capable students, then you will gain more knowledge than if you work by yourself.	• Whether one can learn faster depends on the group one works with • If the students are capable, one will gain more knowledge than if one works individually

b) Identifying themes

i. Titus' transcript

Transcript	Initial Codes	Emerging Themes
Yes, because they are quite senior in their field. They are not only able to understand concepts but they can also teach. Therefore, they definitely know a lot about their own subject and I believe that what they do is right.	• Senior in the subject matter • Can understand concepts • Can teach • Know a lot about their own subject • Believe in them	• Respected his teachers and emphasized their importance • Described his lecturer as experts in their own subject domain and worthy of respect
No definitely not because some students are stronger while some are weaker. If you put them together, they can probably learn more from each other. They can learn each other's mistakes and each other's strengths.	• Some students are stronger while some are weaker • Learn more from each other • Learn each other's mistakes and strengths	• Learning was innate. • Effort was not related with more learning

ii. Warren's transcript

Transcript	Initial Codes	Emerging Themes
Yes, I trust their views because it is quite true for Mathematics where you need to practice and practice. The more you do the more you understand. Whatever he says apply to the subject but not so much on other subjects. It depends a lot on the subjects.	• Trust experts' views • The participant trusted the views of experts to some degree	• Respected experts' views • Described his lecturer as experts in their own subject domain
In collaborative learning, you can ask one another. Whether you can learn faster, it depends on the group you work with. If they are all capable students, then you will gain more knowledge than if you work by yourself.	• Whether one can learn faster depends on the group one works with • If the students are capable, one will gain more knowledge than if one works individually	• Learning was inborn • Disbelieved in hard work and effort

The analyses of first year and final year participants' responses were carried out independently of each other. The first level of analysis took about 90 minutes to two hours to complete for each transcript.

Stages 4 and 5: Theme review, theme name and definition

After I had coded the entire data set, I started rechecking the consistency of my coding. Therefore, at this stage, all the notes were tabled, tidied, and typed out in Microsoft Word, so that I had a clearer view of what I had identified. This allowed me to closely re-examine in-depth to refine and revise the themes so that categories could be clearly formulated within the data set. As posited by Zhang and Wildemuth (2009), it is important to recheck the consistency of the coding as "the coders' understanding of the categories and coding rules may change subtly over the time, which may lead to greater inconsistency" (p. 5).

Although I am unable to assert that I have obtained absolute understanding, I am able to confirm that I have developed a way to comprehend the phenomenon. As the theory suggests, the five dimensions of the epistemological belief system, as stated in sub-section 2.2.2, were used to categorize the beliefs about knowing, while the eight conceptions of learning as described in sub-section 2.3.2, were used to classify the beliefs about learning. With regard to how the participants approach learning, the various methods as discussed in sub-section 2.4.1 were used. Although these categories were used as themes to group the interview responses, it was also noted that "variations might appear during the process of applying the learning beliefs categories" (Brownlee et al., 2009, p. 605). In other words, additional codes might emerge and initial coding would be fine-tuned as analysis proceeds.

When sufficient consistency had been attained, I started making inferences from the themes identified, for example, uncovering the patterns and the relationships between categories. Similar themes were then consolidated and cross referenced to the transcripts to make sure that associations

were done correctly and findings were reflected accurately. For example, participants who demonstrated that they respected teachers and emphasized their importance were grouped into *omniscient authority* category. Any text that could not be grouped with the predetermined categories would be assigned to a new category. Where data within a transcript reminded me of previous research findings, I would make a note so that I could relate and assess my study's results, to ascertain if they corresponded with those of past research at a later stage. Extracts from two transcripts, which show examples of the themes and categories, are shown below:

i. Titus' transcript

Transcript	Emerging Themes	Categories
Yes, because they are quite senior in their field. They are not only able to understand concepts but they can also teach. Therefore, they definitely know a lot about their own subject and I believe that what they do is right.	• Respected his teachers and emphasized their importance. • Described his lecturer as experts in their own subject domain and worthy of respect.	Omniscient authority
No definitely not because some students are stronger while some are weaker. If you put them together, they can probably learn more from each other. They can learn each other's mistakes and each other's strengths.	• Learning was innate. • Effort was not related with more learning	Innate ability

ii. Warren's transcript

Transcript	Emerging Themes	Categories
Yes, I trust their views because it is quite true for Mathematics where you need to practice and practice. The more you do the more you understand. Whatever he says apply to the subject but not so much on other subjects. It depends a lot on the subjects.	• Respected experts' views • Described his lecturer as experts in their own subject domain	Omniscient authority
In collaborative learning, you can ask one another. Whether you can learn faster, it depends on the group you work with. If they are all capable students, then you will gain	• Learning was inborn • Disbelieved in hard work and effort	Innate ability

Transcript	Emerging Themes	Categories
more knowledge than if you work by yourself.		

Each transcript underwent an iterative process approximately three times and the entire process of analysing, re-analysing, evaluating and re-evaluating took about 42 to 50 hours to complete.

Stage 6: Reporting

The five stages, shown above, were reiterated for all the remaining transcripts. When all the transcripts were completed, the list of emerging themes was cross-checked with one another to determine if new themes emerged or if the themes found were common. The final list of themes was then made into a report to capture the experiences and views of the participants. To increase credibility of the report, the interpretation of the data was supported with the actual interview excerpts from the participants. This was to ensure that the interpretation was as accurate as possible.

The report consisted of two main sections. The first section of the report is an in-depth understanding of the background information of the participants. The first year and final year participants are reported independently of each other. The report for both groups includes:

- Participants' expertise
- Participants' activities
- Participants' prior learning experiences
- Participants' learning preferences – past and present
- Participants' notions of using technologies in the classroom and teaching approaches
- Reasons for choosing InfoComm Technology and its association to their learning approaches

The following is an example of the background information of one of the first year participants:

> **Titus**, like Laura, describes himself as being moderately skilled and spends, on average, about 8 hours per day behind a computer, during the school term. However, when it comes to school holidays, Titus is a relatively lower user of technologies, as

he spends much of his time engaged in sports. At our interview session, Titus was actually wearing sports attire and carrying a basketball (observation excerpt, 4/11/2012).

Titus uses technology more for social, entertainment and lifestyle purposes. He shares with me that *"I will use my Android smartphone mostly for music, Twitter, sms or calls and occasionally games. My laptop… is more useful for … games and HD movies on YouTube. Facebook is also important in my daily life as I can skim for any interesting news or events that are happening nearby. It is also easy to contact friends and share media"* (interview excerpt, 4/11/2012).

Of all the participants so far, Titus seemed to have the most negative views about the educational value of technology, even seeing it as a potential barrier to learning. When I asked him if he uses technology for educational purposes, he replied that he preferred technology to be utilised for personal use rather than for academic purpose, because to him, technology could be a possible distraction. Hence, he feels that *"students may be distracted if too much technology is put in one place [in a classroom]…"* (interview excerpt, 4/11/2012).

The second section of the report is the findings and the discussion of each category identified. Based on the key themes being identified, the two groups of participants were compared. Finally, the report concluded with a discussion of how the findings are related back to the research questions. In other words, a concise description of what has been presented in Chapter Five was deliberated.

3.6 Other factors impacting the study design

I now focus on the validity and reliability in order to affirm the quality of this qualitative research.

3.6.1 Trustworthiness and credibility

"Wolcott's strategies" (Gay et al., 2009, p. 377), described below, were adopted to ensure the reliability of my research:

- Listen to the participants – During the interviews, I did not interrupt but waited patiently for the participants to respond. Furthermore, I listened attentively to what the participants said so that more information about the studied topic could be acquired.
- Record interviews fully and accurately – Interviews were audio taped and audio recordings were transcribed to provide a complete and accurate record of what took place. To decrease the possibility of distortion from the findings, notes were taken but they were recorded after the interview ended so that I could stay focused and would not be distracted during the interview.
- Be open in the report – As "bias can creep into the interview situation" (Gray, 2009, p. 376), I explicitly described the contexts in which interviews were conducted and reported any biases that might affect me to develop the questions in a certain manner.
- Write personal thoughts – I recorded how the participants reacted to my questions and noted their behaviour during the interview. Besides, I also recorded how I was performing at each interview. Recording my personal thoughts helped me to identify any gaps that needed to be filled in so as to improve and do better in the next interview. For example, I noted what I should do to reduce the anxiety of the participants, how I should verbalise and modify the interview questions in a manner that was easy to understand, and what questions were needed to elicit essential and important information. Such reflection, which was also termed by Guba and Lincoln (1989) as "progressive subjectivity" (cited in Shenton, 2004a), enabled me to document my thoughts and observations from the beginning to the end of the study, thus allowing me to monitor the effectiveness of the techniques I employed as the study developed.

- Seek feedback – From the recruitment stage to designing the interview questions and conducting interviews, I continually sought advice from my supervisors so that they could help me spot any areas that I might have overlooked.

Furthermore, I prepared a list of interview questions so that the same questions were asked and would not miss out any key areas. For consistency, everyone's interview was an hour long. Additionally, I believe that my education and prior study experiences, such as the good grades which I had obtained from all my postgraduate assignments and projects, helped to increase the trustworthiness of this study. As reported by Shenton (2004a), "the credibility of the researcher is especially important in qualitative research as it is the person who is the major instrument of data collection and analysis" (p. 68). He further advocated that a reader's trust in the researcher is as significant as the adequacy of the processes. The sample data presented in the findings chapter is another way to enhance credibility as the interpretation of the findings was supported with participants' quotations. That is, if the analysis of the data is debatable, readers could make their own judgement based on my raw data.

All of the above not only demonstrates my commitment to obtaining and generating data that was trustworthy and reliable, but also my commitment to transparency.

3.6.2 Interpretation and member checking

I realized that as my participants are students from the Net Generation, I might not be able to understand certain terms that they used. As such, I might interpret the findings wrongly, resulting in invalid data. To ensure consistencies and adequacy, it was necessary to conduct member checks (Fraenkel & Wallen, 2006; Gay et al., 2009) to review the accuracy of my transcripts and also to eliminate any bias which might arise during the transcribing process. For credibility of findings, once interviews had been transcribed, the participants were asked to review their transcripts to

validate their accuracy. If any parts of the transcripts were inaccurate or had been misreported, the participants were allowed to edit the transcript contents and sign them to indicate that they approved of them being used in this research study. After the member check was carried out, I would print out the transcripts, read through and analyse them.

3.7 Summary

This chapter has considered the conceptual framework that framed this study. It also explained the design of the study, including the research questions, research methods, the participants sampling as well as the recruitment strategies and ethical issues. Additionally, the methods used to collect and analyze the qualitative data, as well as other factors impacting the study design were also discussed.

In the next chapter, I present the background information of each participant to foster a better understanding of their IT skills, the types of activities with which they were engaged, their prior experiences, and the learning preferences and perceptions of ICT use in the classroom.

CHAPTER 4 BACKGROUND OF THE PARTICIPANTS

Previous studies suggest that current students have a "natural affinity" with digital technologies (Waycott et al., 2010, p. 1202; Kennedy et al., 2008) and higher technological literacy than previous generations (Brown & Czerniewicz, 2010; Lambert & Cuper, 2008; Oblinger & Oblinger, 2005). Additionally, students with high-level ICT skills are believed to have greater preferences for technology-based learning approaches than those with basic technology skills (Littlejohn et al., 2010). As this study recruited its participants randomly from the School of InfoComm Technology, it makes sense to introduce and to better understand the participants' personal background (in terms of their IT skills, the types of activities, with which they were engaged, their prior learning experiences, as well as their learning preferences and perceptions of ICT use in the classroom).

This chapter not only provides an in-depth understanding of the background information of the participants, but it also gives greater understanding of the ensuing results chapter. In addition, it also addresses the following research question: *What is the extent and nature of Polytechnic students' technology use for learning?*

4.1 Introducing the participants

The total study sample comprised 8 male students (4 male from Year 1 and Year 3 respectively) and 4 female students (2 female from Year 1 and Year 3 respectively). To be eligible for admission to the ICT program, the students must have the following GCE 'O' Level examination (or equivalent) results (presented in Table 2 below). In addition, the students must also have sat for a Science, Design and Technology, Food and Nutrition, or a relevant O-Level School Initiated Elective/Applied Subject. Basic technology skills are not one of the minimum entry requirements.

Table 2 - Entry Requirements

Subject	**'O' Level Grade**
English Language as a First Language	1-7
Mathematics (Elementary/Additional)	1-6
Any two other subjects	1-6

Before I introduce the participants, I briefly outline their demographic data in Table 3 and Table 4.

Table 3 - Summary of First Year Participants

Name	Adrian	Danny	Laura	Nancy	Titus	Warren
Gender	M	M	F	F	M	M
Age	17	17	17	17	17	17

Table 4 - Summary of Final Year Participants

Name	Annie	Charles	Henry	Isaac	Ryan	Zoe
Gender	F	M	M	M	M	F
Age	19	19	19	19	19	19

I now present a brief description of each participant, grouping them by their level of study, that is, I will first describe the freshmen, followed by the final year participants.

4.1.1 Understanding the freshmen - **Adrian, Danny, Laura, Nancy, Titus and Warren**

Adrian believes that he has high-level IT skills in the use of advanced and specialised technologies, such as creating websites and developing mobile applications. He said, "*I am more of an advanced user with regard to IT usage… I write code, learn new programming languages and play with tools like Adobe's Creative Suite…"* (interview excerpt, 2/10/2012). He also reported spending hours and hours exploring computers and developing applications for companies during vacation. His high level of ICT usage is exemplified by the following comment: *"I went without sleeping for 2 days because I was doing some programming for others…"* (interview excerpt, 2/10/2012).

Besides using technologies for work, Adrian also relies upon digital technologies for social and educational purposes. For example, when communicating with his friends, family members and classmates, he uses technology tools, such as Facebook. In terms of educational uses, he described how he would *"use mobile devices, like [a] smartphone and [an] iPod Touch to find information, for example, to check my CCA records... use my laptop to review and edit notes, and access content [learning materials]"* (interview excerpt, 2/10/2012).

When asked about how his secondary school teachers used technology in the classroom, Adrian responded that the students "*had online notes... we [the students] logged in to a learning management system to learn Mathematics… and we [the students] could do them at our own pace"* (interview excerpt, 2/10/2012). Thus, Adrian, only mentioned his teachers using technology in ways that supported traditional, knowledge transmission pedagogies, rather than in ways that enabled constructivist approaches that specifically aim to foster critical and creative thinking, deep learning or student collaboration. This could indicate that this was only use that his teachers made of such technology or it could mean he just did not notice or really value the other educational uses of ICT enough to recall them or mention them when asked about them.

Interestingly, although Adrian deemed himself as highly skilled in IT, he stated that he preferred "*teacher-centred learning because it sets the foundation for the students and also clarifies whatever doubts I have before having my own thoughts and discussion about something"* (interview excerpt, 2/10/2012). While he prefers conventional teaching methods, this was not to the total exclusion of other methods. For example, he believes that the best way to learn is to collaborate with other students and to have more practice.

Moreover, Adrian views technology as a tool of convenience, that is, information, such as content and announcements, is easily accessible and discussion between students and between students and staff can be conducted anytime and anywhere. He focused on how educational technology allowed for resources, like study notes, to be easily shared amongst friends; as well as

how it acted as an administrative tool to ease the job of the lecturers in communicating with students, stating that "*it [technology] is quite important for attendance marking and announcements"* (interview excerpt, 2/10/2012).

Adrian who *"likes to play with a lot of different fields in IT, and not just programming"* (interview excerpt, 2/10/2012), deems that the InfoComm Technology program can provide him with the opportunity to explore different technology tools. Therefore, he chose to enrol in this program. However, despite being an InfoComm student, he still focused on rather superficial, low level uses of ICT in regards to describing his teaching and learning experiences with technology.

Danny, like Adrian, also considers himself *"an advanced user"* as he manages his *"own Web 2.0 site and also creates several apps for iPhone and Windows Phone"* (interview excerpt, 2/10/2012). Although Danny has high-level IT skills in the use of advanced and specialised technologies, he enjoys and prefers to spend time with his family and friends. For instance, "s*ocialising and posting personally created content are some of the personal activities I will engage in"* (interview excerpt, 2/10/2012). Additionally, he also likes to share *"information and photos with my classmates, friends and family"* (interview excerpt, 2/10/2012) using technology tools. Due to the requirements of his program of study (InfoComm Technology), he also relies heavily on technology for school work. He said, "*In Polytechnic, we have an e-learning system where we access our lecture notes and PowerPoint slides. For questions that we are not sure, we will post them on our Facebook group page. My classmates and our lecturers will help to answer those questions or make clarifications"* (interview excerpt, 2/10/2012).

Like Adrian, when asked about his educational use of technology, Danny's responses emphasised low level uses of technology that focused on administration and knowledge-transmission/acquisition as opposed to activities normally associated with deep learning and constructivist teaching. For example, Danny said the actual classroom use of technology is still more related to teacher-centred learning activities rather than student-centred learning. Danny

commented that his current lecturers *"did not really use technology to teach. It was more like they informed the students that the learning materials were on the online learning management system..."* (interview excerpt, 2/10/2012). Sometimes, his lecturers would give out paper notes and slides to the students. Like Adrian, Danny's responses suggested that he frequently used the internet as a technology aid to find specific information and to get necessary information relatively quickly, stating that "*it [technology] is also very useful for searching for more information if you do not know something"* (interview excerpt, 2/10/2012). In the past, Danny not only liked to *"google to find out the terms [concepts]"*, but he also favoured online reading. He said, *"... my teachers liked to use sites like the Bookman Price [Index[1]]. I will read the abstract of the Price authors and I like reading them"* (interview excerpt, 2/10/2012).

However, this focus on knowledge acquisition did not mean he did not also experience and value other types of learning that were more associated with constructivism or deep learning. For example, he added that he favours group work because studying with other students gives him opportunities to discuss and work with his classmates, thus helping him to understand a topic better. Furthermore, in terms of teaching methods, Danny believed in using repetitive practice for subjects like Fundamentals of IT Professional and real understanding and application for subjects such as Computing Mathematics. For example, he said "*I like Computing Mathematics so much that I would like to know how to apply it in real life. For other subjects, like Fundamentals of IT Professional, it really needs hands-on. Given the situation and scenarios, the students will explore. I prefer such a method than just asking the students to do a set of questions"* (interview excerpt, 2/10/2012). In other words, Danny wants to be able to apply what he has learnt to various contexts in real-life, and enjoys exploratory learning; both application and exploration are associated with the deeper, more sophisticated approaches to learning explained in Chapter Two.

[1] Bookman's Price Index (BPI) is an annual guide to the values of used and rare books.

Danny chose InfoComm Technology because he has a strong desire to help and improve the lifestyle of the people. He said, *"I can actually create things out of nothing. There is a sense of satisfaction. It is even more so when the thing you have created is actually helpful to people and they get to use it. Therefore, I like it a lot"* (interview excerpt, 2/10/2012).

Laura describes herself as being moderately skilled because her IT skills only involve *"using Microsoft office such as Microsoft Word and PowerPoint"* (interview excerpt, 2/10/2012). During the school term, she spends, on average, about 8 hours per day using technologies, but she *"uses the computer more during the school holidays because I play games the whole day"* (interview excerpt, 2/10/2012). In other words, her time is largely spent on playing games rather than on completing academic tasks during vacation. In light of what she has shared with me, she appears to use more core and established technologies for both academic and social activities. Apart from playing games, Laura also chats on Facebook. In other words, she uses digital tools, such as social networking sites, mainly to keep track of friends and for entertainment purposes.

Like Danny and Adrian, when asked about her previous and current learning experiences with technology, Laura tended to focus on technology being used to support traditional, teacher-centred type teaching methods. In relation to secondary school, she said, *"the teacher did not use technology to teach. We used the computers in the computer lab to type out our assignments"* (interview excerpt, 14/11/2012).

In terms of her learning preferences, Laura explicitly said that she preferred the face-to-face learning, as she has been exposed to such traditional instruction for more than ten years, hence is used to this method of learning. Laura also added that *"not everything [in the classroom] should be in technology"* (interview excerpt, 14/11/2012). As she has a tendency to lose hard copy course notes or forget to bring them to school, she feels that lecturers should *"upload [the notes] to a website or to the school learning management system so that I can access and read the*

notes" (interview excerpt, 14/11/2012). Thus, she emphasises how technology acted as a useful repository of knowledge, where she can easily access learning materials anytime and anywhere.

As with Danny and Adrian, some of her comments did refer to other types of learning and teaching methods more associated with deep learning and constructivist approaches, such as a preference for group learning that is "*face-to-face where there are contact and interaction with other people"* (interview excerpt, 14/11/2012) more than individual learning. However, even here, her preference for group work seemed to be supported rather conventional learning goals. She explained to me that she prefers group work because *"If I learns through technology, I may not know whether I am right or wrong. But when I interacts with other people, I will know whether my concepts are right or wrong"* (interview excerpt, 14/11/2012). Thus, her focus seemed to be on finding out or confirming the right or wrong answers from other people, which could mean that she wants support from her peers (Kubiatko, 2013; Sandeen, 2008), rather than "self-discovery and self-realization" (Tapscott, 2009, p. 75; Nicholas & Regina, 2008). This therefore suggests a relatively naïve notion of knowledge as simple and fixed and a superficial approach to learning as the acquisition of infallible facts.

When I asked Laura, "*Why did you choose IT as your course?*", she replied: "*Because technology is advancing every day and technology seems to be quite interesting"* (interview excerpt, 14/11/2012). Hence, it seems that Laura's choice is based largely on personal interests as opposed to job prospects.

Nancy regards herself as a basic user, but based on her account of her IT usage, it appeared she was actually underestimating her abilities and she possessed moderate skills in using core technologies for learning purposes. For instance, she states that "*apart from the administrative aspects of the computer, such as, setting up [installing] software… and knowing most of the basic usages of IT*" (interview excerpt, 8/10/2012), Nancy also uses technology to *"engage in education research, art work and connecting with peers… I also use computers for programming…"*

(interview excerpt, 8/10/2012). Her replies suggest that she can do programming, uses technologies to search for information and stay in touch with her friends. It could also mean that she is less familiar with the more advanced functions of technologies, thus, believing that her expertise merely encompasses the required skills necessary for administrative work.

While Nancy seems to use computers extensively for both personal and research purposes, she claims that she spends only about 4 hours per day behind a computer, because she does not have her own computer at home for her exclusive use, but has to share it with her family members.

Like the other participants, Nancy also tended to focus on conventional, knowledge-transmission teaching and learning methods when asked to describe her past learning experiences. For example, she shared with me that she did a lot of note taking in the past, and this had helped her to better retain and remember information.

With regard to Nancy's current learning preferences, she favours "*individual [learning] for the learning part"* and *"group [work] when it comes to doing"* (interview excerpt, 8/10/2012). She said, "*When I learn myself, I have a way of storing information. My way can be so sketchy or doodles that [other] people cannot get it… I need the group effort to actually see whether what I am doing so far is what is required"* (interview excerpt, 8/10/2012). Not only does Nancy require reassurance of her academic performances from her peers, that is, feedback on whether she is heading in the right direction, but she also understands that she needs to collaborate with many people in future. She further explained that *"They [future employers or colleagues] are going to come out with things that I may disagree with but I have no choice but to accept it the way they want it to be…"* (interview excerpt, 8/10/2012).

Like other participants discussed earlier, Nancy's account of how technology can support learning, merely focused on technology as a tool that improves efficiency of communication and accessibility to information more so than as a tool that can also support deep thinking and the construction of knowledge. She feels that *"it [technology] helps a lot in efficiency and with the*

internet; I can access information wherever I am" (interview except, 8/10/2012). Thus, she did state that she thought ICT was important and needed to be used more in teaching. However, her justification for this emphasised the fact that technology was a part of everyday life and, thus, students needed to be familiar with it: *"... In the world today, everyone uses technology. So in the classroom, I do not see the reasons why we are not using"* (interview except, 8/10/2012). Thus, it was not clear that her preference for technology primarily reflected her learning preferences, but more that she feels that when a new technology is developed, one should change and adapt to that technology and educational providers should support this.

Nancy's peers are not only her key influencing factor in her academic performances, but also in her decision to study IT. She told me that she chose InfoComm Technology because she has *"a lot of IT friends who use a lot of programming and Mathematics".* Amongst the first year participants, she is the only participant who mentioned that she chose the course, at least partially, due to peer influence. Nancy's replies also suggest that she wants affirmation from her peers to assure her that she has made the right choice and has chosen the right program.

Titus, like Laura, describes himself as being moderately skilled and spends, on average, about 8 hours per day behind a computer, during the school term. However, when it comes to school holidays, Titus is a relatively lower user of technologies, as he spends much of his time engaged in sports. At our interview session, Titus was actually wearing sports attire and carrying a basketball (observation excerpt, 4/11/2012).

Titus uses technology more for social, entertainment and lifestyle purposes. He shares with me that *"I will use my Android smartphone mostly for music, Twitter, sms or calls and occasionally games. My laptop… is more useful for … games and HD movies on YouTube. Facebook is also important in my daily life as I can skim for any interesting news or events that are happening nearby. It is also easy to contact friends and share media"* (interview excerpt, 4/11/2012).

Of all the participants so far, Titus seemed to have the most negative views about the educational value of technology, even seeing it as a potential barrier to learning. When I asked him if he uses technology for educational purposes, he replied that he preferred technology to be utilised for personal use rather than for academic purpose, because to him, technology could be a possible distraction. Hence, he feels that *"students may be distracted if too much technology is put in one place [in a classroom]…"* (interview excerpt, 4/11/2012).

Like the other participants, it seemed that Titus' teachers did not exploit the affordances of technologies for teaching and learning. Although he stated that *"in Secondary One [which is equivalent to Grade 7], I had e-learning week… there were social [networking] sites…"*, but his teachers "…*did not use it [technology] frequently*" (interview excerpt, 4/11/2012). Thus, this could explain why Titus regards technology as more for personal use than for educational purposes.

Like Laura, Titus' explicitly stated a preference for rather conventional, teacher-centred pedagogical methods. In the past, Titus preferred *"the traditional way, where the teachers explained to us from the textbook and wrote on whiteboard"* (interview excerpt, 4/11/2012). This preference seem to be related to his reluctance to embrace ICT as an important learning tool as he stated a preference for learning that *"is a way of audio learning and not just visual, that is, we cannot just look at the computer screen the whole day"* (interview excerpt, 4/11/2012). I did not ask Titus to elaborate on what he meant by audio and visual learning, but this could be indicative that he is embracing traditional conceptions of learning and regarded teachers and didactic variables like learning content and the presence of teachers as essential elements for learning.

Although his learning preferences remain conventional, he described how he had started to associate learning with his career as he progresses to the senior years, that is, he sees learning as applying what he has learnt to various situations in real life. This focus on application indicated some appreciation for more sophisticated, deeper approaches to learning. He told me that *"if the lecturers give only lectures… I only know what the contents are but I do not know what it is for and*

do not know how to apply it to the different questions. I need the teachers to make [help] us think more" (interview excerpt, 4/11/2012). This may explain why he feels that *"it [teaching] has to be balanced"* (interview excerpt, 4/11/2012), that is, on one hand, he sees teachers and didactic variables as essential elements for learning, on the other hand, he prefers active learning which enables him to *"think more and not just listen to the lectures"* (interview excerpt, 4/11/2012).

Like Danny, Titus chose InfoComm Technology because he has a strong desire to help and improve the lifestyle of the people. He said that he hopes *"to provide a better user experience for everybody. I can do more things that I want to do, and I can also help other people using technology"* (interview excerpt, 4/11/2012).

Warren, who seems to believe that his technology skills were normal, actually described activities that indicated he has some expertise in specialised technologies. For example, his IT skills include "*photo editing using Photoshop, video editing using Sony Vegas, basic programming in Java, and troubleshooting of computer faults"* (interview excerpt, 18/09/2012). Although Warren is highly skilled in specialised technologies, he does not spend more time on the computers during vacation. He said, *"during school holidays, I am working and so it will be less on technology and I donot play games"* (interview excerpt, 18/09/2012).

With regard to how Warren uses technology for learning, he uses it mainly for accessing information and doing online quizzes, as well as for communicating with other students. For example, he said that he has to login to the school's learning management system to do the online quizzes during e-learning week. Besides, Warren also shares that *"for project work, Facebook is very important. During project, it [Facebook] will be [used] almost every day… Apart from Facebook, I will also use Microsoft word, or some websites…"* (interview excerpt, 18/09/2012). Hence, he is predominantly using simple tools (such as the school's learning management system, Microsoft Office and the internet) for his academic learning.

Warren's prior learning experiences also emphasised *"traditional teaching where the teacher would stand in front of the class teaching and using the whiteboard. E-learning was once in a year"* (interview excerpt, 18/09/2012). This might explain why in the past he had preferred the *"traditional way [of teaching]"*, that is, he favours *"lectures where the lecturers show the slides and write notes on the board while explaining"* (interview excerpt, 18/09/2012). However, his learning preferences appear to be quite context dependent. At present, he prefers "*both e-learning and the traditional way"* (interview excerpt, 18/09/2012), because he feels that the traditional teacher-centred method will be more appropriate for subjects like Mathematics, while the use of technology, such as videos and illustrations, will be more suited for other subjects. His responses may imply that he views technology as a useful visualization aid that can help to explain difficult concepts by providing visual representations of them. However, he never really describes anyways in which technology may be used to support more collaborative and constructivist approaches to learning. Another reason for the change in Warren's learning preferences to a greater appreciation of technology-based learning, could be due to the requirement of his program, as he stated that there are *"online learning and online quizzes"* (interview excerpt, 18/09/2012) in one of the modules.

Warren chose InfoComm Technology because he is *"very interested in this area [InfoComm Technology], for example how technology works and how it can help human [people]… … I am very interested to learn more about it as I can make things simpler by using software"* (interview excerpt, 18/09/2012).

4.1.2 Understanding the final year participants - **Annie, Charles, Henry, Isaac, Ryan and Zoe**

Annie claimed that she has basic technology skills as she knew only *"basic Flash programming"* and basic troubleshooting skills, such as *"repairing computer things and solving internet problems"* (interview excerpt, 18/9/2012). She further shared that all her school work was completed in classes and that there was very little homework after school. As such, Annie barely

uses her MacBook Pro though she personally owns it. This could also explain why Annie's computer usage was lower than the other participants. For example, *"during the school term, I will use [a computer] at the most 2-3 times per week"* and even more infrequently, that is, about 3-4 hours per day on a computer during vacation.

When she uses technologies, they are used more for personal and entertainment purposes than for learning. For instance, *"my smartphone is used for [playing] games… for finding information on the spot (for example, Google Maps) or just keeping up with my friends on social networking sites like twitter and Facebook"* and *" sometimes watching videos to pass time"* (interview excerpt, 18/9/2012).

With regard to Annie's prior learning experiences, she felt that technology was only ever used because it was the duty of teachers to use some technologies in class (for instance, mandated by the curriculum). She said to me that *"it was just like another thing to fulfil in secondary school… the teacher would suddenly say let's go to the lab to do some online quizzes"* (interview excerpt, 18/9/2012). She also further mentioned to me that her teachers *"did not use a lot of IT stuff for Science, Mathematics and English. It [technology] was used more for retrieving"* (interview excerpt, 18/9/2012).

Annie appeared somewhat critical of her teacher's reliance on traditional methods and reluctance to use technology. She believes that if students have been *"exposed and having the traditional method for the first 16 years of their life, it [traditional method] will just make them lazy"* (interview excerpt, 18/9/2012). Hence, she feels that "*it is time for a change and a switch*" (interview excerpt, 18/9/2012). Besides, Annie also believes that technology can prepare her for the workforce. This therefore suggests that she recognizes the importance of equipping students with necessary skills, such as digital literacy skills, so that they can be proficient in their workplace and also essential to succeed in this information-rich, complex and globalised environment. Amongst

the final year participants, it was interesting that Annie explicitly associated her current learning with her future career.

However, despite her criticism of traditional teaching methods, Annie, herself, seemed to prefer such methods for her own learning. In the past, Annie liked *"listening to teachers in class and copying down notes from the teachers"* (interview excerpt, 18/9/2012). Her preferred current learning remains unchanged. She still *"prefers the lecturers to be teaching because if they give me a video to watch, I will just copy blindly … and I am not going to ask any questions"* (interview excerpt, 18/9/2012). Additionally, she also feels that teachers not only help to maintain discipline but also help the students to solve problems.

With respect to why Annie has chosen InfoComm Technology, she told me that she had no other alternatives. She wanted to choose Business but she was not suited for business. She believes that she may do well in the program as she *"feels that I am quite good at it [InfoComm Technology]"* (interview excerpt, 18/9/2012). Therefore, she chose IT based on her perceived abilities or past educational performance.

Charles claims that he is *"an average user"* but he said he *"uses Microsoft office products, such as Visio to draw process flow diagrams and visual basic to create websites… [uses] PHP to design a library system for my part time job"* (interview excerpt, 9/10/2012). Although Charles considered himself to be moderately skilled, he actually has high-level IT skills in the use of advanced and specialised technologies.

In the interview, he also stated that he would spend *"12 hours - from morning, about 8 am till end of school which is about 6pm and I continue to use computer after school… it is about the same during the school holidays"* (interview excerpt, 9/10/2012). Regardless of school term and vacation, Charles would spend about the same amount of time (that is 12 hours every day) on the computer.

Like Annie, Charles uses technologies more for personal and entertainment purposes than for learning. For instance, he said, he uses technology *"every day for entertainment purposes such as watching videos and using Facebook…"* and *"most days"* (interview excerpt, 9/10/2012) for academic activities, such as using *"Google doc to jot down notes and serve as reminder… to work on my project with my group mates or while I am travelling"* (interview excerpt, 9/10/2012). Although Charles uses technology for academic purpose, his responses suggest that he uses it more as a reminder and a discussion tool.

As with the other participants, it seems that Charles' secondary school teachers did not fully exploit the educational affordances of technologies. He shared with me that his *"Mathematics teacher in my secondary school spent half the lesson going through a topic, gave us [the students] a lot of questions to practice and quizzes to test us on the topic"* (interview excerpt, 9/10/2012). He also mentioned that *"some teachers do [use technology]. They will summarise the whole chapter using Google doc. The students will go to the link and download the summarised document"* (interview excerpt, 9/10/2012).

Such frequent exposure to conventional teaching might explain why Charles prefers taking down notes for every topic. Although he indicated *"using an iPad to view the compiled notes and to search for more information*" (interview excerpt, 9/10/2012), he uses it more as an information seeking tool to find information and as an organizer than as a collaborative and constructivist learning tool. While Charles believes that technology can improve students' learning, he does not think that it will be useful in learning. Instead, he feels that it is more for entertainment and social purposes. Like, first year student Titus, Charles feels that *"it [technology] can also be a distraction to the students"* because he knows of *"students who go to social networking sites or watch videos during lectures. When the lecturers are going through the lectures, they are not paying attention. They would use notebook for entertainment purpose"* (interview excerpt, 9/10/2012).

Charles chose InfoComm Technology because he is very much interested in the subject. During the interview, he shared with me that *"I always have interest in doing programming, instead of finding it as work to do, I usually enjoy doing it. It is like a game to me"* (interview excerpt, 9/10/2012). In other words, his interest in and love for programming is so deep that he does not view learning technology as a task.

Henry is not certain about his level of expertise initially. When I asked him to describe his IT skill level, he was not able to do so at first as he did not know how he had fared as compared with the others. Shortly afterwards, he shared with me the various skills he has, for instance, he knows multiple programming languages like Java and C++, uses different IT software like Visual Studios as well as develops various applications and websites. Apart from being adept in the use of specialised technologies, Henry also *"builds my own gaming PC to play games"* and *"owns multiple gaming consoles"* (interview excerpt, 22/9/2012). He therefore not only described himself as highly skilled, but also viewed himself as a hardcore gamer.

Henry owns multiple digital devices, for example, he has *"phones on Android and Windows platform"*, and *"among my digital devices, I uses my phone the most"* (interview excerpt, 22/9/2012). He also uses his laptop but it *"is mostly [used] for schoolwork, office work and surfing the net when I am at home. I also use it to read the news as I no longer read the physical [hardcopy] newspaper"* (interview excerpt, 22/9/2012). It is not all work and no play for Henry. Besides doing his schoolwork and office work, he also uses *"social sites but it is limited to Facebook and occasionally Tumblr…to read what others are saying in order to keep up with their lives"* (interview excerpt, 22/9/2012).

Like the other participants, Henry rarely used technology for formal learning purposes during his secondary school days. He told me that *"it [technology] was not used very often. It was still mostly whiteboards and worksheets"* (interview excerpt, 22/9/2012). He added that even now, at the Polytechnic, *"it is still the standard way of teaching, standing in front of the class, using*

slides and maybe access to videos. In a way, it is just using slides, videos, worksheets and practices" (interview excerpt, 22/9/2012).

Prior to joining the Polytechnic, Henry *"did not have a preferred way [of learning]"* as he believed that *"there were not many tried and tested ways to ace examinations"* (interview excerpt, 22/9/2012). However, at present, he favours both a lecturing style and group discussions, because he feels that *"for a new topic, for example, programming, it is always better to have lecturers to explain the basic concepts first. After I have mastered the basic concepts, I prefer the more student-centred based learning, where I can discuss in groups and find out ways to solve the problems before lecturers give out the answers"* (interview excerpt, 22/9/2012).

Henry views technology as an information seeking tool and as a tool to access knowledge anytime and anywhere, for instance, he stated that *"anything I do not know, I can just google and I am able to find an online tutorial to help me. As for the phone, I can actually learn on the go, I can always access knowledge everywhere I go".* Apart from regarding technology as a tool for finding information, Henry does not know if, or how, technology can improve classroom teaching when asked about his views on the use of technology in a classroom. For example, he explained to me that "*there is not much technology can do except for presentations and videos, which has always been that way"* (interview excerpt, 22/9/2012). Besides he also feels that it may be hard for teachers, who are not adept in their IT skills, to use technology in the classroom as he believes that *"students are definitely better than teachers in using technology…"* (interview excerpt, 22/9/2012).

Henry chose InfoComm Technology because *"my interest started when I was in primary school and it grew into a desire to become an IT professional during my junior college days. So I decided to choose IT"* (interview excerpt, 22/9/2012).

Isaac could "*write different computer programs and work with different tools"* (interview excerpt, 23/9/2012). He also added that he is both *"a Windows and a Mac user"*, as well as *"owns an Android, iPhone and Windows Phone Device"* (interview excerpt, 23/9/2012). In view of the

above, Isaac is not only a "big user" (Waycott et al., 2010, p. 1205) of Web 2.0 technologies, he is also very proficient at using the different kinds of tools. As such, when I asked him to describe his level of technology skills, he confidently reported himself to be highly skilled in the use of both advanced and specialised technologies. Regardless of whether or not it was during the school term or vacation, he would spend around 5 hours every day in front of a computer.

Isaac shared with me that he would use technologies for both personal and academic purposes. For example, he *"makes use of my smartphones and laptop to connect to social networking sites to keep me updated of my friends and also topics which I am interested in"* (interview excerpt, 23/9/2012). Although he uses Facebook and Twitter frequently for personal activities, he does not play lots of games. As an active member in the local forums, Isaac prefers reading news from different sites and sources for academic purposes because these sites enable him to learn and understand from various perspectives.

With respect to Isaac's prior learning experiences, it was mainly teacher-centred learning where the teachers used presentation slides to teach and the students listen. As he is so used to a teacher-centred approach, he said there had been no change in his learning preferences since secondary school. In the past, he favoured such instructional delivery method because he feels that this is the fastest way to learn. Now, he still prefers the traditional teacher-centred learning approach because in a teacher-centred learning environment, students who have doubts about certain part of the lesson can ask the teachers at once and the teachers can also clarify any doubts the students may have on the spot. He therefore thinks that this is the best learning method. Although Isaac generally prefers the lecturing style of teaching, he feels that *"it will be good to have more hands-on activities for the students so that I can find out for myself and also to help me understand better"* (interview excerpt, 23/9/2012).

Regarding Isaac's notion of technology, he views technology as a visualization tool. He said, "*the use of presentation slides in class probably allows us to form ideas quickly because we*

are able to see the whole picture…With all the points on the slides, we will be able to understand better. Presentation slides are good for visualization" (interview excerpt, 23/9/2012). He also added that "*with the internet, I can really get a lot more information than in the past"* (interview excerpt, 23/9/2012), thus suggest that he views technology as an information seeking tool.

Isaac's *"passion in technology"* and his strong desire to *"develop useful applications to help the people"* (interview excerpt, 23/9/2012) leads him to have greater preference in IT, therefore, he chose InfoComm Technology as his program of study.

Ryan believed that his skills in core technologies, such as presentation programs, were basic. For instance, he said that his expertise merely included the basic use of a program that is, the skills required to create a presentation.

Among all the participants, Ryan spent the least number of hours on a computer for both personal and academic purposes, as illustrated in the following interview excerpt:

> *R: How often do you use technology for personal purposes?*
> *Ryan: I use it daily for about 3-4 hours a day.*
> *R: How often do you use it for academic purposes?*
> *Ryan: In school, I use it daily for about 6-7 hours, and then when I reach home, I continue to use it for another 1-2 hours.*

He also shared with me that he "*uses them [technology tools] more for personal uses"*. For instance, he would *"use Facebook and Twitter to keep myself updated of my friends around me",* as well as *"Wiki, as I find it a very good place to source for more things"* (interview excerpt, 8/12/2012).

Ryan stated that technology was not frequently used in secondary school. He said, *"we had computer labs in school but we did not use them frequently*" (interview excerpt, 8/12/2012). He further explained that the computers were rarely used by his teachers for a couple of reasons. First, *"during secondary school days, most of the notes were printed out for the students"*. Second, the teachers *"know very well that we [the students] will use the internet if they were to bring us to the*

computer labs" (interview excerpt, 8/12/2012). In other words, he thought that the teachers knew that students would be easily distracted by technology; hence, the usage of technology in the classroom was low.

In the past, Ryan liked to *"read books like National Geographic textbooks and notes. If the project requires me to do research, then I will use the computer. Using computer is not my main form of learning"* (interview excerpt, 8/12/2012). Like Isaac, Ryan felt that teachers should supplement their teaching with more practice based tasks for student. For example, he told me that he "*would like the teacher to teach me the formula, and with some additional information like how this formula comes about, why is it used in this and that way, and more background information like how this is applicable to real life… … I feel that there should be more practical in secondary school than learning all the heavy stuff"* (interview excerpt, 8/12/2012).

With regard to his current desired ways of learning, Ryan *"still prefers traditional teaching and learning because it is more formal than learning through a computer screen"* (interview excerpt, 8/12/2012). He further shared that he *"respects the person who is teaching by actually being there. I feel it is very artificial to learn from the computer screen, unless I am [he is] given instructions to find out certain topics. If I am learning, I should listen to it first hand, rather than through computer"* (interview excerpt, 8/12/2012).

When I asked Ryan about his views regarding the use of technology in a classroom, he replied, "*the students can learn better with the use of videos because they [technologies] can convey better than spoken"* (interview excerpt, 8/12/2012). His response suggests that he sees technology as a visualization tool rather than a constructivist learning tool. He also feels that if the schools were to *"continue using the same media, we [students] will not be able to make full use of what the technology can provide"* (interview excerpt, 8/12/2012), therefore, he deems it necessary for schools to exploit the affordances of technologies for teaching and learning.

Ryan chose InfoComm Technology because *"at that time [that is while he was in secondary school], I was tired of taking examination and learning, I wanted to do something different. So I decided to take animation as I like anime and computer animation"*.

Zoe, like Charles and Henry, thinks that she is *"just an average user"* but actually, she is highly skilled in the use of advanced and specialised technologies. For instance, she does not only have *"office skills"* but also *"programming and networking related skills"* (interview excerpt, 3/2/2013). In other words, she is adept at both programming and networking.

When I asked Zoe how long she would spend on the computer per day, she claimed that she would *"use [it] for about 12 hours [exploring the computer] during the school holidays"*, adding that *"I do not use only computer but I also use smartphone"* (interview excerpt, 3/2/2013). Zoe also stated that during the vacation, technology was used *"more for personal purposes. For example, I listen to K-pop and Korean entertainment news"* (interview excerpt, 3/2/2013). Technology is also used for academic activities, but it is used *"during school term"* to access *"MeL [school's learning management system], get the materials and read about the topic. If the topic is difficult, I will google for more information... I also use twitter, Facebook, google+, talk and msn to communicate with my friends and classmates. She will also share materials [with her classmates] through these network sites…"* (interview excerpt, 3/2/2013).

Zoe shared her prior learning experiences with me. She said *"there were computer labs, and language labs… but we rarely use them"*. She also told me that if technology was used, it was used mainly *"for extra curriculum activities"* (interview excerpt, 3/2/2013) or *"for recording of marks"* (interview excerpt, 3/2/2013). In other words, technology was generally used for extra activities that fall outside the normal curriculum of school education and administrative purposes, like recording of assignment grades.

Previously, Zoe preferred *"the traditional way [of learning]"* (interview excerpt, 3/2/2013). For example, she *"will use pen and paper. Sometimes, I will type my own notes and print them out*

to read" (interview excerpt, 3/2/2013). Now she still shows great preferences in the conventional teaching method. For instance, she prefers her *"lecturers to put up notes before lectures, so that I can read through first to have a very basic idea in my heart"* (interview excerpt, 3/2/2013). Besides reading lecture notes before lessons, she also likes to *"draw diagrams and write down notes"* because she feels that she *"can remember and understand better if I write down notes than typing it out"* (interview excerpt, 3/2/2013). Such traditional learning preferences could be due to her exposure to the conventional teaching environment, as she said that *"for 15 years, I have been trained this way"* (interview excerpt, 3/2/2013).

At first, Zoe does not know how to reply when asked about how technology might be used for teaching. Despite being uncertain, she endeavours to provide a response, stating that *"it is better to use technology to show graphics or explain concepts, than the lecturers writing down all the things"* (interview excerpt, 3/2/2013). Therefore, like Isaac, Charles and Ryan, Zoe feels that technology is important for visualization, that is, to explain difficult concepts. In addition, she also deems that technology should be used more for communication and discussion purposes, because students *"only have 2-3 hours of lectures, and after lectures, it is difficult to find them [lecturers] in their office. So it is better to post questions on twitter, so lecturers can reply"* (interview excerpt, 3/2/2013).

Zoe told me that she is actually *"more into business. Both my parents are doing accounts and I would like to do business like them but they ask me not to do it as it is a very tiring job"* (interview excerpt, 3/2/2013). Zoe therefore took up InfoComm Technology because her father wanted her to do so. She said, "*My father told me that IT is now the trend and every company will need IT personnel"* (interview excerpt, 3/2/2013).

4.2 Summary

As this study randomly sought participants from the School of InfoComm Technology, it makes sense to understand their personal background, for example their IT skill levels, their use of technologies and preferences towards technologies.

In the next chapter, I discuss and compare the two groups of participants (that is, first year and third year students) based on the identified key themes, namely epistemological beliefs, conceptions of learning and approaches to learning. The possible factors that may have an impact on the participants' epistemological beliefs, their learning conceptions, and learning approaches are also explored.

CHAPTER 5 ELEMENTS OF STUDENTS' LEARNING

Chapter four introduced the twelve participants. In the following sections, three main areas will be discussed, namely what the participants believed knowledge was, how they viewed learning and finally how they went about learning or acquiring their knowledge. Before I delineate the various learning conceptions and approaches to learning, I will discuss the epistemological beliefs held by all the participants and the factors that influenced their beliefs.

The following sub-section 5.1 seeks to address the first part of the second research question: *What are the epistemological beliefs surrounding learning with technologies among the post-secondary students, their conceptions of, and approaches to learning?*; as well as the first part of the third question: *How does the students' use of technology influence their beliefs about knowledge, conceptions of, and approaches to learning?* In order to ascertain the participants' beliefs about knowledge and knowing, they were asked a set of questions during the interview (see Appendix D). These interview questions were devised using Hofer's epistemological framework regarding "the nature of knowledge (what one believes knowledge is) and the nature of knowing (how one comes to know)" (Hofer, 2004, p. 46). For example, the participants' beliefs about knowledge were elicited by asking "Ms Jennie Walker feels that understanding, such as knowing how the formula is derived, is not essential. She also confines her instruction to drill and practice. There is no collaboration activities and students work individually. Do you think that this was the right action by the lecturer in this situation? Why? What would you do?" and "Could the teacher be wrong?". Beliefs about knowing were also examined by asking more direct questions, such as, "Do you trust/believe the views of authorities?"

5.1 Epistemological beliefs

In this study, the five categories proposed by Schommer (1990), namely simple knowledge, omniscient authority, certain knowledge, innate ability and quick learning, were used to analyse the

data concerning the student's beliefs about knowing. The students gave responses that exemplified different aspects of all five of these categories. In addition, some of their responses also indicated domain-specific beliefs (Magolda, 2002).

5.1.1 Simplicity of knowledge

As explained in Chapter Two, the category "simplicity of knowledge" refers to a continuum ranging from the "belief that knowledge is best characterised as isolated bits and pieces to the belief that knowledge is best characterised as highly interrelated concepts" (Braten & Stromso, 2006, p. 1029). From the interview excerpts, five first year participants (Warren, Adrian, Nancy, Titus and Laura) and all final year participants (Charles, Annie, Issac, Ryan, Zoe and Henry) gave responses that suggested they embraced, at least some of the time, a sophisticated notion of knowledge as interrelated. Some of Warren's, Adrian's, Charles' and Annie's comments imply a belief that, for at least some knowledge, one needs to understand all the different components of an idea or theory and how they are connected, including the context in which a theory was discovered. For example:

> *Warren: … Sometimes, if you do not understand a point, you do not understand everything.*
>
> *Adrian: … Mathematics is a subject which requires full understanding of whatever the sub-components are, so if you are going to skip on something like the theory or how it is discovered, you are going to skip completely…*
>
> *Charles: It is about the whole module. If you were to skip any sections, there will be a small missing part…*
>
> *Annie: I think it depends actually. For example biology, you have to understand the whole thing. I have to understand the starting before I can understand the end.*

Their focus here seemed to be on the relationships between different pieces of information relating to their current learning, rather than on how this content was related to other experiences or

knowledge that went beyond their immediate learning. The research discussed in Chapter Two claims more that more sophisticated epistemological beliefs usually entail a preference for student-centred approaches to learning, that is, learning involves a process of "understanding and meaning by relating and connecting new material to prior knowledge" (Dart et al., 2000, p. 264). Despite exhibiting this sophisticated epistemological belief, these students did not necessarily prefer constructivist approaches to learning. As explained in Chapter Four, these students often preferred many conventional teaching methods, such as lecturing. However, their favourable view of teacher-centred methods might reflect the fact that these methods enable a lot of interconnected information to be explained succinctly. Thus, sophisticated epistemological beliefs may not be completely incompatible with such traditional teaching methods.

Isaac's and Ryan's comments implied an understanding of knowledge as interrelated and they emphasised the importance of building new knowledge onto existing knowledge. That is, they felt that one had to have a basic understanding of some particular content in order to understand other more advanced content, which implies a belief that at least some knowledge was interconnected. The following interview excerpts demonstrate their beliefs:

> *Isaac: ... as long as you have the basic, the fundamentals of what you learnt, it will be easier for you to move on, be it other subjects...*
>
> *Ryan: ... you will learn addition first, and then progress on with multiplication...*

Amongst the participants who viewed knowledge as integrated to some extent, Nancy, Titus, Laura, Henry and Zoe seemed to embrace a more sophisticated conception which involved connecting knowledge learnt in class to experiences beyond the classroom, as opposed to merely seeing different bits of academic knowledge as interrelated. Their beliefs are illustrated by the following comments where Titus, Laura, Henry and Zoe associated learning with "application" and "practical working situations" (Eklund-Myrskog, 1998, p. 314), and recognised the importance of

connecting learning to their future work and to the real world contexts, while Nancy was able to integrate her prior knowledge, that is, the knowledge which she had acquired from the secondary school, with her current modules.

> *Titus: … I have learnt that by drilling and practice, one can get good grades in examinations but after a while, you will feel that it is not necessary because you cannot relate it to other experiences and cannot apply it to the later part of your life…*
>
> *Laura: Learning and real life is almost related to each other. Therefore, by applying, it makes you learn more and also understand better.*
>
> *Henry: I learnt chemistry in my secondary school but I never have a chance to use chemistry in my life … for Mathematics, I always have to use it, so you have to know and be able to apply.*
>
> *Nancy: … For Chemistry, if I were to say a character dies from suffocation, if I do not know that there is no oxygen on the moon, then everyone will question how a human character manages to do that…*

Out of these final year participants, Zoe was the only student who had the opportunity to attend an internship program when the interview was conducted and this may have supported her to develop an appreciation of the importance of connecting knowledge to experiences beyond the classroom:

> *Zoe: … For my internship, I know how to write program, but I may not be able to solve users' requirements. Therefore, you must know how to apply it. In IT, they will teach you how to gather user requirements, we are taught the steps on how to gather user requirements, I may be able to remember all the steps, but if I don't apply during internship, then it will be a waste.*

The above comments imply an understanding of knowledge as cohesive to the extent that students recognised some relationship between the content being learnt and other experiences and knowledge acquired from elsewhere. The above comments also implied that, to some extent, these

students were able to apply their learning in their daily life, thus, suggesting that they saw education as "relevant" (Davis, 1997, p. 5).

In contrast, Danny was the only first year participant whose interview responses suggested that he tended to see information as isolated. He never described knowledge as interconnected in any way and he appeared to be more "fact-oriented" (Schommer, 1990, p. 498), regarding knowledge, at least in some subjects, as consisting of isolated facts (Ryan, 1984; Schommer-Aikins, 2004). For example, he claimed that "*For weaker subjects, I will compartmentalise it"* (interview excerpt, 2/10/2012). This could indicate a learning strategy he used to remember content but he never described synthesising or connecting information to gain a deeper meaning beyond this compartmentalising. This could explain why he really only ever described using technology for information seeking purposes as opposed to deep learning (as described in sub-section 4.1.1). For instance, he said he would "*google to find out the terms"* and liked *"learning from the internet, reading through all the sites"* (interview excerpt, 2/10/2012).

Those participants, who seemed to embrace the more sophisticated notion of knowledge on the simple knowledge continuum, did not indicate an explicit preference for digital learning. Rather, as explained in sub-sections 4.1.1 and 4.1.2, they appeared to favour conventional learning methods, such as a "more direct instructional style" (Ravert & Evans, 2007, p. 326). This could indicate that the availability of digital tools had little effect on the participant's development of these sophisticated epistemological beliefs. Such findings are different from earlier research (Tsai & Chuang, 2005; Tu et al., 2008) where students with more sophisticated epistemological beliefs had a higher preference for technology-based learning environments. That is, they would more frequently use digital tools to explore information in an in-depth, critical manner (Dillon & Gabbard, 1998) and collaborate with peers to construct knowledge (Braten & Stromso, 2006).

5.1.2 Omniscient authority

As described in the literature review, omniscient authority is referred to as knowledge being "handed down by authority rather than derived from reason" (Schommer, 1990, p. 499). In this category, all first and final year participants (regardless of whether their epistemological beliefs were otherwise naïve or sophisticated) seemed to exhibit a considerable degree of trust in the views of 'experts' and 'authorities' (such as teachers), seeing them as an important and reliable source of information. For example, during the interview, Titus, Laura, Annie, Zoe and Isaac described their lecturers as experts in the field and worthy of respect. For instance, Titus shared with me that his lecturers are *"quite senior in their field. They are not only able to understand concepts but they can also teach. Therefore, they definitely know a lot about their own subject and I believe that what they do is right"* (interview excerpt, 4/11/2012). Similarly, when talking about her lectures, Laura stated that *"experts know more about it [content] and have more experiences [in their area of work]"* (interview excerpt, 14/11/2012).

While this high regard for teachers does not mean that the students saw them as the only source of knowledge or that they thought knowledge did not emanate from reason or other sources, some of the participants' responses could indicate a lack of a critical orientation towards knowledge claims and the opinions of 'experts' and an overreliance on authorities for knowledge. Some students emphasised seeking assurance from teachers (or even other students) that their understandings or work were correct. For instance, Annie stated that, *"during group discussions, we ask each other questions, but we do not dare to believe our friends even though they may be right. We will still end up asking our lecturers"* and *"actually I am more on the grade side, so I will just ask the lecturers for questions that are likely to be on the examinations"* (interview excerpt, 18/9/2012).

Danny, a first year participant, specifically mentioned that he is not afraid that the information on the Google site *"is false because they have been checked by Professionals*",

indicating an uncritical and epistemologically naive reliance on 'professionals' (interview excerpt, 2/10/2012). This is consistent with the fact that when asked about learning preferences and educational technology use, so many of them emphasised teacher-centred learning and direct instruction, and technology as a depository for information, especially information emanating from the teacher (see Chapter 4). For example, the most common use of educational technology the students described as valuable was that teachers *"upload [the notes] to a website or to the school learning management system so that I can access and read the notes"* (Laura, interview excerpt, 14/11/2012).

A degree of deference to teachers can also be strategic in terms of academic success. For example, teacher feedback can be used as a tool to reassure students that they were "on track to being successful" (Tapscott, 2009, p. 94). From this, one could suggest that regardless of age or even of one's epistemological beliefs, the presence of teachers was considered an essential condition for learning and fulfilling course requirements (Wang & Tsai, 2012).

While the participants were quite accepting of the views of experts to some degree, some of the first year participants, like Nancy, Adrian and Danny, were more mindful that, at other times, knowledge is changing and should be personally constructed. Their responses indicated the more sophisticated epistemological belief that knowledge can be constructed by using others' views to modify one's own views. For instance, Danny replied, "*I would not take it completely. Advice is [sic] always suggestions. I would take it and then see how it works from there. I will try it out and if it works, of course, go with them, but if it does not help at all, I will find another way to do things"* (interview excerpt, 2/10/2012). Likewise, Adrian believed his lecturers but he would not just blindly accept their viewpoints. He said, "*I will believe them but I would also like to check for myself and form my own views of certain things. It is not follow blindly what they say. I would say rather than to have people telling you that their views are important, we should develop our own views about certain things"* (interview excerpt, 2/10/2012). He also suggested that rather than rely

entirely on the information provided by teachers, he would extend on it through his own, further independent study: "*I would also say that sometimes when my Mathematics teacher taught me how a formula was derived, on my own, I would go home, find out more and do a lot of reading on it…".* In other studies, such sophisticated views were more likely to be held by individuals at the end of their program of study (Kitchener et al., 1993; Magolda, 2002; Schommer, 1998). However, in this study, they were also demonstrated by these first year participants.

The responses of Ryan and Warren indicated that their beliefs about the notion of authorities as bearers of knowledge were dependent on the discipline (that is, domain specific) or conditional upon other factors. For example, during the interview, when I asked the participants if they agreed with the following statement: *"Professor Warren Esty, a Professor of Mathematics at Montana State University and Assistant Professor, Norah Esty, of Mathematics at University of California Berkeley believed that Mathematics is like a sport. One, even the best player, must practice a lot to get good results?",* Warren and Ryan replied as follow:

> *Warren: I trust their views because it is quite true for Mathematics where you need to practice and practice. The more you do the more you understand. Whatever he says applies to the subject but not so much to other subjects. It depends a lot on the subjects.*
>
> *Ryan: It depends on how the lecturers explain. If they can explain it with clarity, then it should not be wrong. But if he is not sure, then I will probably check a bit more…*

Warren's response above is consistent with Hofer's (2000) finding, where students were found to believe in and trust the views of the authorities more in some domains (that is, Mathematics) than in others, such as Sociology (cited by Marra & Palmer, 2008). The findings suggest that while these participants (Nancy, Adrian, Danny, Warren and Ryan) had strong beliefs in authorities as reliable sources of knowledge, they also believed that the reliability of authorities was either somewhat conditional or, in the case of Nancy, Adrian and Danny, that all knowledge is

more tentative and can be constructed from a variety of sources. Such findings were in line with prior studies, where many students were found to have a more complex combination of simple and advanced epistemological beliefs that often varied depending on the context (Brownlee et al., 2009; Cano, 2005; Schommer-Aikins & Easter, 2006; Phan, 2008; Walker et al., 2009).

It was also found that out of the twelve participants, eight of them would go to their peers for assistance in addition to, and usually prior to, teachers or 'experts'. They are Warren, Adrian, Nancy, Titus, Laura, Danny (who are the freshmen), Ryan and Charles (who are the final year participants). This is illustrated in the following excerpts from interviews, for example:

Adrian: Most of the time, classmates first.

Nancy: Yes, I will approach them [classmates] first.

Ryan: [I] will first ask my friends who do not have difficulty with the topic…

Charles: [I] prefer to approach my peers for help first…

In the interviews, I tried to gain a better understanding of why they preferred to approach their friends first when faced with difficulties in their school work. The reasons provided by these participants were similar. First, it appears that they felt their classmates were friendlier and easier to talk to than the lecturers. Thus, they felt more comfortable approaching their classmates. For instance, Adrian said, "*they are closer to me and we can talk about it [a topic]*..." (interview excerpt, 2/10/2012), while Nancy shared that "*they are more accessible and I am able to ask them in all sorts of different manners and they will still get it"* (interview excerpt, 8/10/2012). Second, they could learn better, communicate and understand each other better. For example, Ryan cited that *"friends can explain the topic in a way different from our lecturers. With that, it helps me to understand the topic better"* (interview excerpt, 8/12/2012), while Charles also shared that "*learning through peers, actually helped us learn together and actually learn more efficiently, as*

compared to asking our lecturers" (interview excerpt, 9/10/2012). In addition, they also felt that their classmates were more approachable or accessible than the lecturers. For instance, Warren said, *"… lecturers do not have much time and they usually have meetings, so we cannot ask them every question"* (interview excerpt, 18/09/2012). It was also possible that the participants were influenced by the traditional Asian culture which emphasises "respect and obedience" for authorities (Zhu et al., 2008, p. 414), including within academic contexts. Hence, they may have tended to approach their classmates first as they were reluctant to approach and question their teachers and would only do so as a last resort. Thus, the fact that many of them emphasised teacher-centred pedagogies did not mean that they did not also value more collaborative approaches to learning, such as discussing ideas with peers. However, it was not clear from their comments that nature of this student's collaboration was constructivist (for example, dialogue aimed at critical exploring diverse perspective and constructing new meanings), it could have been focused on supporting more conventional teaching and learning (for example, comparing answers and understandings with those of peers to check that they are correct).

5.1.3 Certainty of knowledge

As explained in Chapter Two, certain knowledge is referred to as a range of beliefs spanning from knowledge as absolute (naïve) to knowledge as evolving and fallible (sophisticated) (Dahl, Bals & Turi, 2005). Annie was found to be the only participant who indicated that she might see knowledge as sometimes "absolute and unchanging" (Braten & Stromso, 2006, p. 1029). This is exemplified in the following interview excerpts where the participant appeared to believe that information simply comprised indubitable knowledge (Schommer, 1998). When asked about what was most important in the learning process, Annie replied *"I think that the acquisition of specific facts [knowledge] is important in a learning process"* but didn't mention anything like critical analysis of information or integrating information from various sources (interview excerpt,

18/9/2012). Her focus on the acquisition of facts could imply a belief that knowledge is absolute because it suggests that one can simply memorise and store away these ready-made bits of information without having to think critically or deeply about them. This connection between learning approaches and epistemological beliefs has been described by others (Chang, 2005; Davis, 1997; Ravert & Evans, 2007; Tolhurst, 2007).

Although Annie implied that she thought knowledge was sometimes absolute, she also believed that *"drill and practice is only useful in certain subjects"* (interview excerpt, 18/9/2012). This, could imply that she believes knowledge is absolute or, at least, more certain in some subjects than in others. That is, she seemed to think that it was appropriate to memorise fixed knowledge in subjects through drill and rote but this was not possible in other subjects. As Annie was a final year student her tendency to sometimes see knowledge as fixed and certain was inconsistent with earlier studies where students in the later stage of their courses were less likely to believe that knowledge was "absolute and certain" (Mori, 1997, p. 3; Schommer-Aikins et al., 2003).

While Annie's comments above could be taken to mean that she sometimes had naïve beliefs about knowledge, other comments she made implied she also recognised that knowledge could be somewhat interrelated. As described earlier in sub-section 5.1.1, Annie's comments imply a belief that, for at least some knowledge, one needs to understand all the different components of an idea or theory and how they are connected, including the context in which a theory was discovered. For example, she said, "*I think it depends actually. For example biology, you have to understand the whole thing. I have to understand the starting before I can understand the end*" (interview excerpt, 18/9/2012). These findings concur with many studies suggesting that students were found to simultaneously hold a complex combination of simple and advanced epistemological beliefs that were often context dependent (Brownlee et al., 2001; Brownlee et al., 2009; Cano, 2005; Schommer-Aikins & Easter, 2006; Phan, 2008; Walker et al., 2009).

Previous research (Braten & Stromso, 2006; Bendixen & Hartley, 2003) also reported that students who considered knowledge as "given and stable" (p. 1038) were less likely to have a preference for technology-integrated learning environments or using digital tools to explore information. This could explain why Annie also preferred non-technology based learning environments, as explained in sub-sections 4.1.2.

In contrast, Nancy, Danny, Adrian, Laura (the first year participants), Henry and Zoe (the final year participants) gave responses that suggested they believe knowledge to be more complex, context dependent, tentative or even fallible. The following interview excerpts lead me to believe that these participants did not regard knowledge as absolute. For example, they responded:

> *Danny: … there are many possibilities to solve a problem; we do not have to follow a fixed way…*
>
> *Adrian: … we should also take what's good from their [lecturers] views and try to apply to our own. You cannot take a view 100% by itself.*
>
> *Zoe: … the [real] world situation is more complex than we have learnt in school*

Amongst these six participants, two final year participants (Henry and Zoe) clearly embraced a more advanced notion of knowledge as changing and uncertain. Therefore, these findings, to some extent, were consistent with those of Dahl et al. (2005); Lin and Tsai (2008a); Yoshiko (1997); as well as Schommer (1998), who reported that it was students in their senior year of study who were more likely to "appreciate multiple perspectives [and] be willing to modify their thinking" (Schommer, 1998, p. 558). That is, older learners were susceptible to more sophisticated beliefs. Such advanced epistemological beliefs could be due to their pragmatic views and more imminent entry into paid work or the 'real world'. In sub-section 5.1.1, it was noted that Titus, Laura, Henry and Zoe associated learning with real working situations. This was particularly evident with Zoe who had done an internship in preparation for entry into the workforce. For

example, Zoe further shared with me that, *"it is better to teach them [students] the real life problems. Because in working life, as I've attended internship, I know that the things you learnt in school are really not applicable in working life, so you must have the experience to know how to apply them*" (interview excerpt, 3/2/2013).

Research has also found that students who regarded knowledge as more "uncertain and evolving" (p. 603), were more inclined to critically evaluate when they read and learned something and, consequently, they were more likely to use multiple sources rather than depend on a single source for information (Brownlee et al., 2009). This was reflected in the responses of some of these participants. For example, when I asked Nancy, Laura, Henry and Zoe how they learnt best, the students replied:

> *Nancy: I did a lot of research. Textbooks do not provide much information, so I read articles and see what experiences other people have, for example in the medical area.*
>
> *Laura: After the teacher has taught us, I will go to the different websites to read the different views and ideas about the topic.*
>
> *Henry: For a new topic, for example, programming, it is always better to have lecturers to explain the basic concepts first. After I have mastered the basic concepts, I can then proceed to the more student-centred based learning, where students can discuss in groups and find out ways to solve the problems before lecturers give out the answers.*

However, when asked about the sort of teaching they preferred, these same students also valued, and even emphasized, conventional teaching approaches, such as a lecturing style of teaching and taking down notes. This was explained in sub-sections 4.1.1 and 4.1.2. This suggests that a preference for teacher-centred pedagogies is not necessarily inimical to seeing knowledge as constructed and fallible. Such learning preferences could also be strategic. That is, students may adopt a particular approach to learning – for example, memorising the right answers for

examinations, even if they realize that in ‘real life’ knowledge is more complex and tentative and cannot be uncritically accepted.

5.1.4 Innate ability

Innate ability is characterised as beliefs spanning from the notion that the ability to learn is inborn to the notion that the ability to learn is developed over time (Schommer, 1990). Through analysing the interview data, it was found that three first year participants (Danny, Laura and Nancy) and five final year participants (Ryan, Zoe, Henry, Charles and Isaac) seemed to hold the more sophisticated belief that learning was gradual and could be improved over time, at least in some contexts. For instance, Nancy believed that she learnt from her experiences and mistakes, while both Charles and Zoe felt that multiple repetitious exercises were the only way to perfect one’s skills. This is exemplified in the following responses:

> *Nancy: For my own development, it is about a lot of experiences and also I got to learn about how making errors actually helps a lot more than not making any errors at all. Even now, I get uneasy if I do not get any errors. I feel that errors are the one that improves you a lot…*
>
> *Charles: We need a lot of practice to do well. Even if you are talented, you will not pass the exams without practicing*
>
> *Zoe: Drill and practice is correct, because we are not good at anything when we are born, so we should practice to become good*

The above responses imply that these participants were willing to work hard to improve their knowledge and skills, rather than assuming that one’s capabilities were rather fixed and natural or that learning should come easy. This attitude may also reflect dominant cultural ideas about work ethic and success. Hence, it was congruent with previous research where Asian students who are brought up in a conventional teaching and learning environment that stresses “effort, endurance and

hardwork" (Chan & Elliott, 2004, p. 827), have a greater desire to achieve more and will work hard to do so (Chan & Elliott, 2004; Liang et al., 2010; Zhu et al., 2008). With respect to this, they were more likely to believe that learning could be improved through effort and, thus, were more willing to try out various approaches when encountering academic difficulties, work hard and accept complex academic tasks as well as persist to succeed (Chan, 2011; Corte et al., 2002; Paulsen & Wells, 1998; Schommer-Aikins et al., 2003; Tolhurst, 2007; Walker et al., 2009).

This could also imply that these participants developed higher self-efficacy beliefs, where they believed in their own ability to complete a task (Corte et al., 2002). Such high self-efficacy might also be attributed to their genuine interest in their program of study. For example, as mentioned in sub-sections 4.1.1 and 4.1.2, Danny's and Isaac's interest in their course resulted from a strong desire to help people and improve their lifestyles, while Laura's and Henry's choices were attributable to their interest in technology. Furthermore, it could also mean that these participants see education as "relevant" (Davis, 1997, p. 5) in the sense that they could see how to apply their learning in their daily life. In sub-section 5.1.1, it was noted that Laura, Henry and Zoe associated learning with real working situations. This could, therefore, explain why they were keen to work hard, were ready to take on complex academic tasks and were determined to succeed as they could see the real world applicability and benefits of the knowledge and skills acquired.

These eight participants did not seem to demonstrate strong preferences for constructivist, technological learning environments. Rather, they seemed to prefer a learning environment which involved conventional teaching and learning, which is illustrated in sub-sections 4.1.1 and 4.1.2. This is somewhat inconsistent with studies by other researchers which revealed that students with more sophisticated epistemological beliefs have a greater preference for "sophisticated study strategies" (Schommer & Walker, 1997, p. 184) and technology-based learning environments (Tsai & Chuang, 2005; Tolhurst, 2007).

On the contrary, the responses of two first year participants (that is Titus and Warren) and one final year participants (Annie) indicated that they seemed to believe that learning was innate to some extent, as exemplified in the following interview excerpts:

> *Titus: … some students are stronger while some are weaker. If you put them together, they can probably learn more from each other…*

> *Warren: Whether you can learn faster, it depends on the group you work with. If they are all capable students, then you will gain more knowledge than if you work by yourself…*

> *Annie: … only half is true because genius also plays a part… in classes where people are very good in certain subjects, they do not even need to study and they can score super well and people like me get jealous of them.*

These responses gave a sense that Titus, Warren and Annie might believe that people had natural capabilities that could determine or limit their capacity to learn, regardless of how much effort they put in (Mori, 1997). However, only Annie's response really indicates a belief that such natural capacities may be such a significant learning factor that someone may not even need to study because they are so gifted. Such belief about 'innate' academic ability can be influenced by their experiences and interactions with their classmates (as illustrated in Titus', Warren's and Annie's interview excerpts).

Their belief that capacity to learn is, to some extent, innate could mean that additional educational tools, such as technology, might have little positive influence on Titus, Warren and Annie because they are not very receptive to the notion that such tools can really improve learning (Bendixen & Hartley, 2003, p. 24). This is supported by earlier description of the participants (as shown in sub-sections 4.1.1 and 4.1.2) where they did not really describe any significant benefits of technology-based learning environments. Though Warren seemed to employ technology for learning, it was used more as a rote learning tool (that is, as a repository for ready-made knowledge) rather than a collaborative, constructivist learning tool. Thus, the results seem consistent with the

findings from previous research (Bendixen & Hartley, 2003), which revealed that students who tended to believe that academic ability is innate and fixed (Dahl et al., 2005), were less likely to exploit technology tools. In addition, it was also reported that learners who believed that learning ability was fixed (Mori, 1997) tended to employ "quick and superficial learning" methods (Dahl et al., 2005, p. 263). For instance, Annie told me that "*When I have finished, I will ask for the lecturers' opinions... If the suggestions are good, then I will ask him whether it will add to my marks. If he says yes, I will improve but if he says no, I will just leave it*" (interview excerpt, 18/09/2012). Unlike typical Net Generation users, who loved to explore new things (Tapscott, 2009), Annie appeared to find the quickest way to obtain information or a solution, instead of engaging in exploratory learning.

5.1.5 Quick learning

This category is defined as a continuum spanning from the naïve belief that learning occurs quickly or not at all, to the sophisticated belief that learning occurs gradually (Dahl et al., 2005). Out of the twelve participants, none of them clearly exhibited the belief that learning occurred quickly or not at all (Walker et al., 2009). Rather, their responses suggested that they believed that understanding was usually acquired gradually and that good grades in examinations could only be achieved through repeated exercises, study or learning experiences of some sort. This is illustrated in the following statements, for instance:

> *Laura: Yes, most subjects require more practice… but drill and practice is not required for English, it is based on one's own experience and one's contact with the language*
>
> *Zoe: If you are not very good in Maths, but you practice a lot, you will be able to do better.*
>
> *Henry: You cannot just learn one day and then know it the next day. You will still have to practice*

Adrian: [I] would try to do a lot more … when my Mathematics teacher taught me how a formula was derived, on my own, I would go home, find out more and do a lot of reading on it.

Charles: One certainly needs more practice to do well in exams. All the students have to go through these practical lessons if they want to score well.

The above responses could suggest that the first year participants (Laura and Danny) seemed to embrace a more sophisticated conception of learning than the final year participants (Zoe and Charles). For example, Laura believed that one can learn better from more learning experiences and repeated practice. However, Zoe's response seemed to focus on performance on assessment tasks, indicating that she may have associated learning with achievement on formal assessment tasks and, thus, had a rather instrumental or strategic approach to learning more so that a sophisticated one aimed at deep understanding of content. These beliefs that knowledge is acquired progressively could reflect the fact that these students also believed that the capacity to learn was not innate but a capability developed over time through effort, as discussed in sub-section 5.1.4. As such, these participants tended to take ownership of their own learning and were also more willing to put in effort and time.

5.1.6 Domain-specific beliefs

Domain-specific knowledge is defined as the knowing how, where and when to obtain certain facts or utilise specific procedures (Alexander & Judy, 1988). All of the 12 participants (except Isaac) were not only able to classify different subject knowledge, but they were also able to describe where and when to acquire different knowledge for different subjects. This is well exemplified by some of the participants' comments, for instance:

Nancy: Compared to other subjects, Mathematics is like a new language and it requires a lot of practices… For languages … I think it is really reading and I never really practice…

Warren: I do not think it [drill and practice] applies to all subjects, especially for History. It does not mean that the more you write, the more you will know because you have to understand the theory behind and know why it happens. So by doing more does not necessarily mean you will learn more.

Laura: … it [drill and practice] is only for Mathematics… drill and practice is not required for English. It is based on your own experience and your contact with the language.

Ryan: … For Mathematics, it is quite clear cut, for example, what is right and what is wrong…But for subjects like languages, History and Geography, they could be a little more subjective...

Charles: For other subjects, I need more understanding instead of practice. Without understanding, I will not know how to apply it.

The above data suggested that the participants' epistemological beliefs differed in contexts, that is, between disciplines, or domains of study (Brownlee et al., 2001; Paulsen & Wells, 1998; Schommer-Aikins et al., 2003). For instance, they believed in using repetitive practice for subjects like Mathematics and emphasised real understanding for subjects such as the Humanities (Muis, Bendixen & Haerle, 2006).

Only Isaac (a third year participant) seemed to believe that drill and practice was important for all subjects. Although he felt that repetitive practice was particularly important for Mathematics, he also seemed to believe that drill and practice was appropriate for other modules. For instance, he said "*it [drill and practice] is definitely critical but they are not doing it currently in the school"* (interview excerpt, 23/09/2012).

Although these participants were in the first year of their study and specialised in technology, they seemed to simultaneously exhibit both naïve and sophisticated epistemological beliefs. These findings seemed to be in line with prior research findings, suggesting that one could

embrace a complex mixture of both, but one belief could be more desirable and dominant than the other at any given time (Schommer et al., 1997; Brownlee et al., 2009). The findings, however, contrasted with those obtained by Magolda (2002) who found that students completing majors in subjects like Technology and Engineering tended to embrace simple epistemological beliefs more than students majoring in subjects like the Humanities and Social Sciences. There was no evidence of such a connection here between the students' study major and their epistemic beliefs.

Below, I focus on the possible factors that might influence their epistemological beliefs.

5.1.7 Possible factors influencing participants' epistemological beliefs

The interview data on technological expertise, exemplified in sub-sections 4.1.1 and 4.1.2, revealed that some first year participants (for instance Adrian, Danny and Warren), and most final year participants (such as Charles, Isaac, Zoe and Henry), had demonstrated a high level of competency in the use of technologies. For example, they were not only proficient in multiple programming languages but they also developed applications and websites and were adept at repairing computers. For some participants, the data suggested that an advanced level of technological expertise correlated with having many sophisticated epistemological beliefs (that is, in the case of Adrian, Danny, Warren, Charles, Isaac, Zoe and Henry). As mentioned in the literature review, sophisticated epistemological beliefs were positively related with higher order thinking skills (Chai et al., 2009a), which involved analytical skills and making judgments. These sorts of higher order thinking skills may also be involved in this advanced technology use. Therefore, the participants' advanced epistemological beliefs could be related to the higher-order thinking activities suggested by their advanced technology use.

However, this connection between technology use and epistemological beliefs was not evident for other participants. Competency with technology did not seem to correlate with Titus', Laura's, Nancy's, Ryan's and Annie's epistemological beliefs. As discussed in sub-sections 4.1.1

and 4.1.2, these participants were relatively lower users of technologies and merely embraced the required skills necessary for administrative tasks and/or simple tasks. Despite their moderate skills in technologies, they were also found to have various sophisticated epistemological beliefs.

The above findings could mean that other factors, like one's educational context and the teaching approaches used within it, might have a greater or equal influence on the participants' epistemological beliefs.

As discussed in the literature review, a learning setting is thought to have an effect on students' epistemological beliefs (Erdem, 2008; Hong & Lin, 2010; Yilmaz-Tuzun & Topcu, 2010). For example, students in a constructivist learning environment tend to move towards constructivist views of knowledge, while students in a conventional and didactic teaching environment, were more likely to embrace "objectivist" (that is, non-constructivist) (Erdem, 2008, p. 98) views. In analysing the interview data, it was possible that the didactic and conventional teaching environment that all the participants described being so frequently exposed to (as illustrated in sub-sections 4.1.1 and 4.1.2) may have encouraged some of them to embrace some of the naïve epistemological beliefs that were conveyed during interviews. In doing so, the students might have the impression that knowledge is pre-existing and provided by others and this might lead students to believe that the learning is, to some extent, "uncontrollable" (Paulsen & Wells, 1998, p. 369). Furthermore, we have seen many students emphasised the online learning systems as key repositories of knowledge that is "*they [lecturers] will give out traditional paper notes and slides"* (Danny, interview excerpt, 2/10/2012). The emphasis of such teaching methods could give the students the impression that knowledge could be acquired largely through accessing and comprehending notes and slides, which in turn might influence them to view knowledge as consisting of isolated facts.

Similarly, Charles said *"… my Mathematics teacher in my secondary school gave us a lot of questions to practice and also quizzes to test us on the topic"* (interview excerpt, 9/10/2012). Such

teaching approaches, that is, repeated practices, might lead Charles to think that rote learning is an essential element of learning, which in turn might influence him to think that knowledge is absolute and fixed. On the other hand, Nancy mentioned the use of different teaching approaches, such as, those that involved demonstrations, the internet and flash animation. For instance, she told me that *"For my programming class, my lecturer will use presentations [demonstrations]. At the same time, he will also use game samples from the internet…"* (interview excerpt, 8/10/2012). Such teaching approaches might encourage her to utilise multiple sources rather than a single source for information. It is possibly due to these various teaching approaches, that Nancy perceived knowledge to be more tentative and interrelated.

While the participants in this study were predominantly exposed to a conventional teaching environment, the epistemological beliefs showed that there were more final year participants with different aspects of sophisticated epistemological beliefs. As discussed earlier, more final year participants believed in complex rather than simple knowledge; in learning capacity as something to be developed rather than as innate; in knowing as domain specific; as well as in the notion that learning may take time and effort rather than being quick. In view of this, the educational context did not seem to completely determine the participants' epistemological beliefs; rather their beliefs could also have been influenced by their advancement through school and university. This was in line with studies conducted by Cano (2005), and Walker et al. (2009) where they found that "maturation" (Cano, 2005, p. 205) and the amount of educational experience one had over the years contributed to the development of more advanced epistemological beliefs. That is, the higher the educational level of students, the more complex were their epistemological beliefs. Often this seemed to be connected to the fact that they associated learning with real world contexts and recognised the importance of learning in relation to their future work beyond their schooling (Eklund-Myrskog, 1997, 1998). This was apparent with the research participants in this study. For example, Zoe, who had the opportunity to attend an internship, viewed learning as required in order

to obtain new knowledge to further enhance her work and achieve her goals in her career. She said, *"…in working life, as I've attended internship, I know that the things taught in school are really not applicable in working life, so you must have the experience to know how to apply them"* (interview excerpt, 3/2/2013). She further shared that collaboration is important as she *"learns how to share and appreciate others' ideas …"* (interview excerpt, 3/2/2013). She regarded such skills as essential for competency in the paid workforce or the 'real world'. This focus on entering the workforce could partially explain why, in general, the final year participants in this study tended to have more sophisticated epistemological beliefs than the first year participants.

As we have seen, many participants' also held the advanced epistemological belief that learning could be developed through effort (as explained in sub-sections 5.1.4 and 5.1.5), which could possibly be influenced by the traditional Asian culture which stressed "effort, endurance and hard work" (Chan & Elliott, 2004, p. 827). Therefore, this could partially explain why most participants did not believe in the notion of quick learning and innate ability; tended to take ownership of their own learning and were also more willing to put in effort and time to obtain the best results.

Furthermore, such beliefs about hard work and persistence could also be shaped by the participants' interest in the program. As stated by Ryan, *"interest plays a major part… if you are interested in something, you will be more willing to learn"* (interview excerpt, 8/12/2012). This could justify why most of the participants, who had exhibited a strong interest in the program (illustrated in the various sub-sections 4.1.1 and 4.1.2), were more willing to put forth effort in learning, such as, having more practice sessions to excel in examinations. For example, Charles said *"For application questions, we actually have to practice more to do well in examination"* (interview excerpt, 9/10/2012).

The findings of this study also suggested that social contexts, that is, the friends with whom one interacted or worked with, might affect one's epistemological beliefs. For example, Annie had

witnessed how her friends did well in their examinations without studying. As stated earlier in sub-section 5.1.4, she said, *"You can see in classes where people are very good in certain subjects, they do not even need to study and they can score super well and people like me get jealous of them"* (interview excerpt, 18/9/2012). For that reason, peer influence seemed to have shaped Annie's belief that academic ability was innate and that learning occurs quickly.

The next sub-section highlights what the participants think about learning and the possible factors that might affect their learning conceptions.

5.2 Conceptions of learning

In this section, I focus on examining the various learning conceptions described by the first and final year participants and the influence of their use of technology on conceptions of learning. This section addresses the following research questions: "*What are the epistemological beliefs surrounding learning with technologies among the post-secondary students, their conceptions of, and approaches to learning?"* and *"How does the students' use of technology influence their beliefs about knowledge, conceptions of, and approaches to learning?"*

During the interview, the participants were given three scenarios to read and they were asked a range of questions, such as, "How do you view learning?", "In your opinion, what is learning?", and "How do you know when you have learnt something?". The categories described by Tsai (2004a) and Marton et al. (1993, cited in Lee et al., 2007), as discussed in Chapter Two offered a valuable framework to analyse the data. These categories are: memorising, preparing for tests, calculating and practising tutorial problems, increasing one's knowledge, applying, understanding, and seeing something in a different way and changing as a person.

Based on the participants' descriptions of their learning experiences, responses were grouped according to the categories identified by Tsai (2004a) and Marton et al. (1993, cited in Lee et al., 2007). As a result of the analysis, the first year participants were found to exemplify eight

conceptions of learning, with a new category emerging, that is, learning in terms of didactic instruction. Such emergent categories provided further richness to the data. On the other hand, the final year participants were found to embrace aspects of all conceptions of learning except for the notion of learning as an interpretative process aimed at the understanding of reality. The student's responses in relation to the different categories of conceptions of learning are detailed below.

5.2.1 Learning as memorising

This conception is described as the memorization and storage of definitions, equations, procedures and terms with the primary purpose of reproducing it for examinations (Lee et al., 2007; Watkins & Akande, 1994). In other words, there was no active sense-making activity (Marshall et al., 1999); rather they were trying to store as much information as possible in order to reproduce it in examinations (Lee et al., 2007; Watkins & Akande, 1994).

From the interview excerpts, three first year participants (that is Adrian, Laura, Nancy) and two final year participants (Ryan and Henry) emphasised some elements of the memorising conception of learning. For example, when I asked the participants how they viewed learning, Laura said she would *"absorb the contents or everything that the teachers deliver"* (interview excerpt, 14/11/2012); Nancy stated that *"…when I practice, I practice by remembering the formula that the teacher gives"* (interview excerpt, 8/10/2012), while Adrian shared with me that he would *"make my own notes, constantly revise them and try to memorise the key points"* (interview excerpt, 2/10/2012). Although Ryan and Henry did not explicitly express that they would primarily learn by heart, their comments suggested that they viewed memorising as at least one key aspect of learning, as illustrated below:

> *Ryan: For short term learning, memorising can actually help to remember certain facts. For example, if my lecturer informs me that I will be tested in a particular topic, and if I keep going through the topic, it will be easier for me to answer the questions …*

Henry: When I am working, there will be no guides or teachers to give me tips on how to do well in my job, so I have got to have the knowledge and remember what I have studied…

Adrian's responses led me to believe that he was trying to learn by remembering certain patterns and formulas to perfect one's skills rather than through acquiring knowledge by real understanding. Laura's, Nancy's and Ryan's comments seemed to point to the idea that through memorization, they would be able to do well in at least some examinations. Although Henry had connected academic learning to his future career, that is, he saw learning as obtaining new knowledge to further improve career-related skills, his learning conception emphasised the volume of knowledge acquired rather than relating and applying that knowledge. As postulated by Tsai (2009), students who were graduating and joining the workforce tended to have a more instrumental mentality in their views about learning. As such, Henry's beliefs might be due to his pragmatic focus on entering the workforce.

These findings were different from Eklund-Myrskog (1997), whose study indicated that students at the end of a course were more likely to embrace a qualitative view of learning than those at the start of the course. Such conceptions of learning could be largely governed by the schools' needs and expectations (Eklund-Myrskog, 1998) and it could also be influenced by one's own desire for learning (Tsai, 2004a). Due to their yearning for knowledge, they saw learning as involving memorizing and producing (Chan, 2011), which in turn stimulated them to learn more through surface approaches like repetitious exercises and rote memorization.

Although Warren and Zoe also held similar views to the other participants, there were differences found among them. Adrian, Laura, Nancy, Ryan and Henry discussed storing as much information as possible with the purpose of reproducing it for examinations or preparing themselves with the necessary knowledge to succeed in work, while Warren and Zoe described trying to memorise as a means to gaining understanding. During the interview, they explained how

memorization had helped them to learn, rather than just perform on assessment tasks, as exemplified by the following comments:

> *Warren: … for Mathematics, the more [practice] you do, the more you will understand. For me, it is the case, that is, the more [practice] I have, the more I will understand. So it is better for me to do more.*

> *Zoe: During class time, we have no time to go and explore what the lecturer is teaching. I have to memorise what the teacher says, then when I am free and revising, I will think back why the lecturers says so*.

Such an approach to memorization could arguably align with Cliff's (1998) belief that memorization could be associated with "meaning-making and developing understanding" (p. 207), and in turn, allowing students to remember the information better (Chan, 2011). Therefore, learning which involves remembering and producing as well as learning relating to understanding complemented each other (Chan, 2011).

5.2.2 Learning as preparing for tests

In this study, four first year participants (that is Danny, Warren, Titus, Laura) and four final year participants (Annie, Ryan, Henry and Charles) were found to embrace aspects of the notion of learning as preparing for tests, that is, learning is seen as studying and achievement on assessment tasks (Tsai, 2009). This is exemplified by the fact that when asked about how they viewed learning, many responses focused heavily on assessment when describing learning preferences, as shown in the following excerpts, for instance:

> *Danny: … in group work, if I get group members who do not want to pay attention in their assignments, my grades may be pulled down. But if I do get a nice group, I will learn very fast, very well and get to do a lot of things. That is why I like group work but the thing I do not like is that it is attached to grades. For grades, individual work will be a lot better...*

Warren: … when the lecturer is going through last year's papers, I will ask him the questions that may come out for examination… The lecturers will share with us what the important areas or topics are that we must know. I will then indicate this on the PowerPoint slides. During my revision, I will go through all those that I need to know and I make sure I know.

Laura: To get better grades and to get into the career I want in the future.

Henry: If possible, I will ask my lecturers to vet through first to see whether it is ok, whether it is up to an A grade or not. If not, I will compare the project with my friends, to see if there is anything I can add in.

Ryan: I will try to push myself to do more ambitious things, a little more than the previous time and what is required… Sometimes I will try to explore things to make my assignments more interesting…

Charles: … I will actually approach the lecturer to see what he is expecting from the assignment, and how I did for the assignment so far… Do more research work and additional stuff.

Previous studies showed that such assessment focused conceptions of learning were more commonly found among students at the beginning of the program (Eklund-Myrskog, 1997, 1998), but in this study, it could also be identified among the final year participants. This, therefore, suggested that students, irrespective of age, were results-driven, that is, they regarded success in examinations as of paramount importance and, perhaps, even as evidence that learning had taken place. To attain high scores in examinations, these participants were strategic so as to excel in examinations and obtain good grades. For example, as stated above, Henry would "*pick good team mates…recheck and redo…ask lecturers… compare the project with friends*" (interview excerpt, 22/9/2012). These findings also implied that participants, whose conception of learning

incorporated some elements of the preparing for test approach to learning, were more likely to take ownership of their learning and also to get the job done (Davis, 1997).

In order to gain a sense of what the participants thought the primary purpose of learning was – that is, for examination purposes, for self-development or for future career - I probed further by asking them to elaborate on their aims for learning. In the interviews, I found that the beliefs embraced by many of the participants seemed to be attributed to their pragmatic and instrumentalist attitudes, that is, they associated better grades with getting a good qualification, which in turn would lead to a better job. For instance, Danny shared with me that *"to get a better job in the future, studying is the way to go and it is also the point of learning"* (interview excerpt, 2/10/2012). Similarly, Annie also replied, *"[good grades] can help her get into a better school, better qualification and better job"* (interview excerpt, 19/9/2012). Ryan and Henry shared similar views, for example, Ryan felt that *"how they [students] will be assessed in the future will be based mainly on their grades*" (interview excerpt, 8/12/2012), and Henry said, "*the first thing in our mind is always to do well. If not, you will not be able to go anywhere. When you think about your future, grades are always the first you think of …*" (interview excerpts, 22/9/2012). The interview data therefore revealed that both the first year and final year participants not only considered learning as involving attaining high scores, they also believed that good academic scores could lead them to better colleges and better careers in the future. In other words, they believed that assessments played an important role in determining how well a student performs in school and the students' opportunities for further study (Tsai, 2004a). On this point, the views of both groups of participants were consistent. Such findings were inconsistent with the claim that students who were close to graduating and joining the workforce tended to have a more instrumental mentality in their views about learning (Tsai, 2009).

5.2.3 Learning as drill and practice

From the data, it appeared that most of the participants, embraced aspects of the drill and practice conception of learning at least some of the time. As learning through repetitive practice and reinforcement were emphasised by participants in this study, the classification referred to by Tsai (2004a) as "calculating and practising tutorial problems" (p. 1739), was retitled to "learning as drill and practice". In this research, the participants believed that not only could drill and practice help them gain a better understanding of the content but it could also help them attain good grades in examinations. For example, the participants stated that:

> *Warren: … it is quite true for Mathematics where you need to practice and practice. The more you do the more you understand…*
>
> *Adrian: There is element of a lot of practices to make perfect...*
>
> *Henry: …if I practice a lot, I will get to practice different kinds of questions, so I am able to solve a variety of questions… in an examination, I only have a certain amount of time … If I do not have much practice, most likely I will not be able to answer questions in an examination, and will lose out.*
>
> *Ryan: it [repetitive exercises] not only stimulates my mind to figure out which formula to use, but it also better prepares me should I come across the same question again…*

These comments seemed to point to the idea that these the participants believed that when learners repeatedly practiced a procedure, the skills would be so deeply ingrained in them that they would be able to do any tasks easily. This could explain why they deemed drill and practice to be important. In addition, the data might also suggest that the participants were concerned with the end results as many reiterated that practice was important for performance on assessments.

Amongst the participants' interview excerpts, the first year participants seemed to agree that Mathematics, in particular, required repetitive practice. In analysing the interview data, it was found

that the lecturers would post additional questions for the participants to practice apart from the class exercises. For instance, Warren cited, *"… the lecturers will give us past year papers to try"* (interview excerpt, 18/09/2012), and Adrian also mentioned to me that *"the lecturer gives us tutorial work to do in class… He also gives us some other set of worksheets to do by ourselves, so I can understand more"* (interview excerpt, 2/10/2012). Such teaching and learning activities could explain why they regarded learning as involving repetitious practice. While the participants deemed drill and practice necessary for Mathematics, they were also mindful that such repetitive practice was only applicable to certain subjects. For example: Warren replied, *"I do not think it applies to all subjects, especially for History…"* (interview excerpt, 18/9/2012); and Adrian felt that *"drill and practice is good but there are also other things that I need to supplement it with"* (interview excerpt, 2/10/2012). This could probably be due to their beliefs in domain-specific knowledge, where they were able to understand and apply different learning approaches in different subjects, as discussed in sub-section 5.1.6.

As mentioned earlier, Annie was the least enthusiastic about the importance of drill and practice, mostly because she seemed to think it was inadequate if one did not have natural ability not because she favoured deeper learning approaches. When I asked her if she believed that repetition and drill would lead to good grades, she replied, "*No, only half is true because genius also plays a part*" (interview excerpt, 18/9/2012). This could be attributed to her beliefs in innate ability, as illustrated in sub-section 5.1.4. In addition, Annie also recognised that this approach could be domain specific, stating that "*drill and practice is only useful in certain subjects*" (interview excerpt, 18/9/2012). It was earlier mentioned in sub-section 5.1.6 that Annie was able to identify and distinguish between hard and soft domains, as well as select appropriate learning approaches for different subjects. This could, therefore, explain why she also regarded learning in some subjects as involving drill and practice.

5.2.4 Learning as the increase of simple knowledge

Like learning as memorising and learning as preparing for tests, this conception emphasises the quantity of information acquired (Byrne & Flood, 2004; Marshall et al., 1999). However, according to Tsai (2004a), learning as the increase of simple knowledge might also be associated with students' longing for personal growth or learning as transformation of the self. As indicated in sub-section 2.3.2, such a personal desire for learning could stimulate the students to want to acquire more new knowledge. Here, this category is focused on the quantitative aspect and is referred to as the "acquisition and accumulation" (Lee et al., 2007, p. 213) of discrete pieces of information (as learning as transformation is addressed as another category).

From the data, it appeared that all participants, except Zoe and Annie (who were third year participants), appeared to be more inclined to focus on the volume and quantity of information although they did not explicitly describe learning as the acquisition of isolated information. For example, both Warren and Titus (who were first year students) believed that working in a team, could help them gain more knowledge as they can draw on each other's skills and learn from one another. That is, they emphasised the fact that collaboration provided access to a greater amount of knowledge, rather than on things like social skills, discussion or exploration. This is illustrated in the following excerpts:

> *Warren: I gain more knowledge if I work with students who are better academically than to work alone.*

> *Titus: …it [collaborative learning] is quite good because I get to learn others' perspectives, and not just limit to what the lecturers know and see. Therefore, I can actually learn more things.*

Another first year participant, Laura also believed that "*add[ing] more knowledge"* (interview excerpt, 14/11/2012), would help her academically and also in her career. For instance,

she said, *"additional information is better as additional new knowledge can help us understand better. We may also need to use it in the future"* (interview excerpt, 14/11/2012). Such a conception embraced by the participants might be influenced by their motivation for learning, that is, learning was driven by their desire to pass and score good grades on examinations or to get a better job in future, which was indicated in sub-section 5.2.2. Due to this motive, they were stimulated to acquire more knowledge (Tsai, 2004a, 2004b), which in turn might influence them to believe that learning is the "acquisition and accumulation" (Lee et al., 2007, p. 213) of discrete pieces of information

The strong emotion that the final year participants felt about this category was reflected in their comments. For example, Charles preferred class activities where he *"can research more…"* because he felt that he might *"learn something from the lecture but not most of it"* (interview excerpt, 9/10/2012). It was mentioned earlier that learning as the increase of simple knowledge might be associated with students' yearning for learning or longing for one's own growth. Therefore, like the other first year participants, Charles' conception of learning can also be related to his "personal desire for learning" (Tsai 2004a, p. 1744), which in turn could stimulate him to acquire more new information.

Earlier, it was noted that most of the participants seemed to embrace some elements of the preparing for the test conception of learning. For instance, in sub-section 5.2.2, when asked about learning, Henry, a final year participant, shared that "*I would do everything that I needed to do. If it is a group project, the first thing is to pick good team mates… to put in a lot of effort to recheck and redo. If possible, I will ask my lecturers to vet through first to see whether it is ok, whether it is up to an A grade or not. If not, I will compare the project with my friends, to see if there is anything I can add in"* (interview excerpt, 22/9/2012). Such a purpose of learning, that is, regarding test grades as the evaluating criteria of the learning outcome, might prompt Henry to want to obtain and accumulate more knowledge, which, in turn, might influence him to embrace such a conception.

5.2.5 Learning as applying based on understanding

While the participants seemed to focus on more reproductive views of leaning during their interviews (Marshall et al. 1999), such as memorising, preparing for tests, drill and practice, as well as the acquisition and accumulation of discrete information, most of them (all first year participants and four final year participants, that is Charles, Zoe, Ryan and Henry) still maintained that applying new information and understanding was more important than merely memorising specific facts. For example, when asked, "*What do you think is important in a learning process?"*, the participants responded as follows:

> *Titus: I would say understanding the concept is more important because I can find facts from a lot of sources. Understanding is something where I carry it for the rest of my life once I have learnt it. Facts may change and I may forget the facts. Concepts rarely change, therefore understanding the concepts is always more important…*
>
> *Charles: Understanding is more important. If I do not understand the theory, I will not know how to apply it. Even if I have the facts, I also do not know how to use it.*
>
> *Zoe: Understanding and applying. If you just get all the facts, you will only have the facts. You are not able to apply it and you don't know how it works. So when you start working, you don't know how to do it. You must be able to apply it, you may have the concepts, but because you cannot show what you have, your supervisor, or bosses will not know what you are good at. You might be very good in learning at school but if you are not good at work it is useless.*

Learning as understanding was the common response made by these participants. This was consistent with Tsai's (2004a) and Byrne and Flood's (2004) studies in that most of the participants seemed to believe strongly in applying knowledge to practical contexts rather than in merely learning by remembering and repetition. In other words, they felt that students needed to understand

before they could apply the knowledge obtained from classes to new problems in the real world. This could also mean that they saw the importance of learning with understanding in their future work (Eklund-Myrskog, 1997). As posited by Eklund-Myrskog (1998), students at the end of their education tend to relate learning to real-life contexts. Nonetheless, in this study, this attitude could also be identified among the first year participants.

It was evident that some participants valued understanding and application of knowledge and the extent to which they would put this in to practice was context dependent and somewhat strategic. For example, while Ryan recognized the importance of real understanding, he would rely on memorization if time was a concern. For example, he said, "*If there is not enough preparation time, then I will memorise it and cram in as much information as I can... If time is not a factor, then I will take my time to understand the formula*" (interview excerpt, 8/12/2012). This implies that time and workload might influence how a student viewed learning and could inhibit deep learning and understanding.

5.2.6 Learning as an interpretative process aimed at the understanding of reality

This category (described by Saljo, 1979, cited in Eklund-Myrskog, 1997) was not identified in either Tsai's (2004a) or Marton et al.'s (1993) studies (cited in Lee et al., 2007), but it was found in this study. In this view, learning takes place in the "real world" (Byrne & Flood, 2004, p. 28), that is, learning within this conception helps one to discover a better way to view and interpret the world around them in new ways (Lee et al., 2007; Chiou & Liang, 2012). Such a sophisticated skill is thought to be acquired at a later stage of education (Eklund-Myrskog, 1998). In this study, there was no final year participant that exhibited such an idea of learning, but only two first year participants (that is, Adrian and Nancy) embraced this conception, as illustrated in the following comments:

Adrian: *When you know something and happen to see something related, you are able to link the two together, because you realised they are related. Sometimes, when I was walking on the street, and I see something, it would remind me of a concept that I learnt previously. If you can still remember it, then you have good ground work.*

Nancy: … In Biology, I learnt about how the human body works. If the doctor were to advise me not to eat certain things because this is what they will lead to, instead of being suspicious, I will be able to know which part of the body the doctor is referring to and how that part of the body works…

The participants not only viewed learning as applying, but it also appeared that they were trying to reinforce their knowledge, by applying theory to real life and forming their own understandings (Eklund-Myrskog, 1998). This was similar to Marshall et al.'s (1999) conception of learning, where the ability to analyse and apply knowledge to new situations in the real world allows students to see things in their own way.

5.2.7 Learning as changing as a person

This conception of learning was described as "personal transformation" (Marshall et al., 1999, p. 304), that is, when one works or interacts with other students one acquires new perceptions and views things differently. This consequently resulted in students seeing themselves differently and also having their own perceptions of the world around them as a result of their learning (Byrne & Flood, 2004; Marshall et al., 1999).

Four first year participants (that is, Laura, Nancy, Adrian and Titus) and three final year participants (Ryan, Charles and Zoe) appeared to hold some elements of the "changing as a person" conception of learning, especially in relation to collaborative learning tasks. For example, the participants responded with the following:

Nancy: Life skills. I am now more aware of my behaviour and my discipline, which is more of character growth and also adding on knowledge. I also think ahead a lot more now

because I realise that whatever learning, like leadership and the things I learn, are essential for my work, the area which I am working, and group collaboration.

Adrian: …Learning is not in the form of education, but for life-long learning. Of course, views will shape how much you learn, the method of learning and what things you do with your knowledge and how you can trust information.

Ryan: It [working and interacting with others] will probably help you to understand your friends better, learn more about other people, for instance, his working style… and know how to work with them…

Zoe: When you are doing team work, you will know the weakness of the leader… and will not make the same mistake

Charles: … working with others will improve how we actually argue our points, and letting other people accept our ideas or accepting other people's ideas.

The above responses could imply that participants viewed learning as working with others and knowing how to interact with others. They believed that by collaborating with the other students, they gained opportunities to interact with one another and understand the working styles of different people, which in turn would help to develop one's skills in the area of social, teamwork, negotiation and leadership skills. Nancy and Adrian claimed that learning is "a continuous or lifelong process" (Peterson et al., 2010, p. 174), which would broaden their views and improve personal development. These responses suggest that collaborative learning could be particularly valuable for fostering deep learning that encourages self-reflection and transformation of the self, as opposed to the mere acquisition of facts or performance on individual assessment tasks.

The findings were consistent with Marshall et al.'s (1999) study, which revealed that students embracing this concept, reflected on their "own changes as a person" (p. 304), which led to an increased understanding of themselves. Such findings were also similar to what was reported by Eklund-Myrskog (1997, 1998) who saw the importance of learning with understanding to their

future work. This might explain why Ryan, Charles and Zoe, who were in their final year of study, deemed working with others to be important. However, in this study, such conception of learning was also identified among the first year participants.

5.2.8 Learning in terms of didactic instruction

This category has not been identified by any past research, but it had emerged considerably in this study. As previously noted in sub-sections 4.1.1 and 4.1.2, most of the participants seemed to favour conventional teaching modes, such as teachers' instructions and "instructional content", at least some of the time (Tsai, 2000, p. 200). This finding was not in line with the common claim that the Net Generation has a short attention span for teacher-centred learning (Brown, 2000; Lambert & Cuper, 2008; Pence, 2009). While others have suggested that the Net Generation became uninterested easily with conventional teaching approaches and preferred to have fun when working and studying (Tapscott, 2009), such behaviour and preferences were not found among the participants involved in this research study. Rather, where academics were concerned, they often preferred to stay focused on learning clearly specified course content and seeking out authorities, which were predominantly their teachers, for advice. For example, when asked about preferred teaching styles, Isaac mentioned that he *"like[s] lecturers to be [standing] in front, talking and explaining everything, slide by slide"* (interview excerpt, 23/9/2012). Another student, Laura, said she preferred the *"traditional way because I have been using the traditional way to learn for more than 10 years and I am already used to it"* (interview excerpt, 14/11/2012). These sorts of responses might suggest that the participants regarded the presence of teachers and "transmission teaching approaches" (Streitwieser & Light, 2010, p. 347) as essential elements for learning (Wang & Tsai, 2012). Perhaps this explained why all the participants seemed to hold some elements of the "didactic instruction" conception of learning.

Now that I have discussed the data I have about the participants' conceptions of learning, I will highlight some of the possible factors that might influence their conceptions of learning.

5.2.9 Possible factors influencing participants' conceptions of learning

As explained in the literature review, components such as classroom teaching (Chan, 2011; Kek & Huijser, 2011); learning environments (Lin & Tsai, 2009; Trigwell & Ashwin, 2006); students' learning experiences (Wang & Tsai, 2012); educational contexts (Tsai & Kuo, 2008); and Chinese culture (Chan, 2011) seem to correlate with conceptions of learning. It was this literature that has been used in this section to explore whether the research participants' technology skills, prior learning experiences and other contextual factors may have influenced their conceptions of knowledge and learning.

In sub-sections 4.1.1 and 4.1.2, most of the participants had described themselves as moderately to highly skilled regarding the use of technology. It was also outlined in these sub-sections that all participants used technologies extensively. Despite the fact that most participants had moderate to advanced technology skills and all were frequently exposed to various technologies, they did not really stress the importance of the use of technology in the classroom. Rather, as explained in sub-sections 4.1.1, 4.1.2 and 5.2.8, most emphasised their preference for didactic instruction and conventional teaching modes. Therefore, their frequent use of, and competence with, technologies did not seem to have a direct effect on their conceptions of learning. Instead, it appeared that other factors were more likely to affect how the participants viewed learning. I now discuss the possible influences on the conceptions of learning of the participants in this study.

Earlier, it was found that the lecturers were often using whiteboards and other conventional learning materials (such as notes and slides) to teach, as well as conventional teaching approaches and learning activities that emphasized drill and practice. The use of conventional teaching

approaches which the students were often exposed to (explained in sub-sections 4.1.1 and 4.1.2) might lead to the participants adopting some low level conceptions of learning, such as the memorising conception of learning, aspects of the notion of learning as preparing for tests, aspects of the drill and practice conception of learning, some elements of the increase of simple knowledge conception of learning as well as some aspects of the didactic instruction conception of learning (shown in sub-sections 5.2.1, 5.2.2, 5.2.3, 5.2.4 and 5.2.8). The participants' frequent exposure to the conventional teaching environment and their beliefs in a mix of lower and higher level conceptions of learning, might also explain why they emphasised didactic teaching methods when asked about their learning and teaching preferences (as discussed in Chapter Four).

Certain conceptions of learning were often found grouped together. As demonstrated in sub-sections 5.2.2 and 5.2.3, when a participant described learning as "preparing for tests" (Tsai, 2009, p. 1093), the participant was also more inclined to emphasise working hard and putting in effort through repeated practice. For example, Warren was found to embrace aspects of the notion of learning as preparing for tests, as a result, he also viewed learning as drill and practice, that is, he believed that drill and practice not only help him gain a better understanding of the content but it could also help him achieve good results in examinations. This could explain why all of them embraced some elements of the drill and practice conception of learning because they all adopted some degree of learning as preparing for the test conception of learning.

Additionally, one's notions of learning might be influenced by one's epistemological beliefs. As exemplified in section 5.1, some participants were found to believe in the sophisticated notion of the capacity to learn as developing over time, as opposed to it being an innate ability. When students believed that learning was gradual and could be improved over time, they were also more determined to work hard through repetitive exercises (Corte et al., 2002; Paulsen & Wells, 1998; Schommer-Aikins et al., 2003; Tolhurst, 2007; Walker et al., 2009). With such beliefs, their conception of learning incorporated aspects of the notion of learning as drill and practice. For

instance, in sub-sections 5.1.4 and 5.1.5, Zoe believed that learning could be improved gradually. Such beliefs might have led her to embrace some elements of the drill and practice notion of learning, as illustrated in sub-section 5.2.3.

As postulated by Chan (2011), traditional Chinese culture, which stressed hard work and effort, as well as the process of thinking and understanding, rather than reading or memorization, might also have a significant effect on both constructivist and reproductive views of learning. For instance, being brought up in a traditional environment may have influenced some of the participants to see learning as involving drill and repetitive practice, as shown in sub-section 5.2.3. Such a process, which involves effort, reflects a more quantitative notion of learning (Chan, 2011). On the other hand, traditional Asian culture might also lead to participants believing in the application of new information, that is, applying what they have learnt to new situations (Tsai, 2004a), which is more related to a qualitative view of learning (Byrne & Flood, 2004). This was well exemplified in sub-section 5.2.5 and 5.2.6.

Like epistemological beliefs, one's interest in the program also seemed to correlate to one's conceptions of learning. For example, Ryan reckoned that *"interest plays a major part… whether you want to study more or read up yourself, it boils down to one's interests"* (interview excerpt, 8/12/2012), while Henry believed that *"if the lecturers did not teach well, you will not be interested in the subjects. As such, you will not want to find out and you will also not have the personal drive to want to succeed"* (interview excerpt, 22/9/2012). In other words, one's willingness to learn and one's willingness was connected to one's interests. In sub-sections 4.1.1 and 4.1.2, most of the participants were found to exhibit a strong interest in their program. This could explain why they were more willing to spend time and put forth effort in learning, such as having more practice sessions in order to score good grades in examinations. Hence, this explains why the participants, such as Ryan and Henry, embraced aspects of the drill and practice conception of learning, as exemplified in sub-section 5.2.3.

To improve the quality of the learning experience and also because of the diverse learning approaches and learning preferences embraced by individual students, it is important to have a deep understanding and insight into how students learn (Wishart, 2005). I now turn to examine how the participants approached learning and the possible factors that might affect their choice of learning approaches.

5.3 Approaches to learning

So far, I have looked at the epistemological beliefs and the learning conceptions of the participants as well as the various possible factors that might impact their beliefs about knowledge and conceptions of learning. This sub-section, which focused on how the participants approached learning and the influences on the learning approaches of the participants, will seek to answer the last part of the second research question, as well as the last part of the third research question: *What are the epistemological beliefs surrounding learning with technologies among the post-secondary students, their conceptions of, and approaches to learning? How does the students' use of technology influence their beliefs about knowledge, conceptions of, and approaches to learning?*

To evaluate the learning approaches adopted by the research participants, the following questions were asked:

1. How do you think you learn best?
2. What are your preferred ways of learning?
3. Could you tell me how you go about learning in various situations?
4. If the assignment grade contributes significantly to your final semester grade, what strategies would you use to help you plan and do the assignment?

The data collected were analysed based on the learning modes identified by Marton and Saljo (1976), namely deep and surface approaches (cited in Almeida et al., 2011); and Biggs (1987), that

is, ‘strategic’ or ‘achieving’ (cited in Dogan et al., 2012). They were used as a rubric to examine the results.

As defined in section 2.4, a deep approach is regarded as having an intrinsic motivation to seek meaning and an understanding of the course material through sophisticated learning strategies (Gijbels et al., 2008), such as, reflecting, relating and applying one’s knowledge to practice (Cheng & Tsai, 2012; Rodriguez & Cano, 2007). On the contrary, a surface approach is focused on remembering and repeating information by means of rote learning, making only a minimum effort with the extrinsic aim of meeting the course requirements (Evans et al., 2003; Rodriguez & Cano, 2007). Strategic or achieving approaches are largely influenced by examinations (Almeida et al., 2011). Therefore, learning can occur through either deep or surface approaches, depending on the context. Students with this approach work hard to obtain the best results and use various learning methods to help them achieve their goal (Dogan et al., 2012; Ling et al., 2011).

Two key learning approaches were frequently adopted by the participants. These were the surface approach and the strategic approach. Although most of the participants were found to embrace aspects of high level conceptions of learning and sophisticated epistemological beliefs, no participants described using deep approaches to learning most of the time. I will explore each of these approaches in turn.

5.3.1 Surface approach – “reproducing”

A surface approach, which was to learn “without reflecting on either purpose or strategy” (Alemida et al., 2011, p. 152), was exhibited by all the participants, except Nancy and Titus. When I asked the participants “how do you learn best?”, they replied:

> *Adrian*: *… I will make my own notes, constantly revise them and try to memorise the key points…*

Warren: I will read a lot and where there are no people. For example, I will read in my room, close the door, and try to memorise.

Charles: …for theory questions, we actually have to understand and memorise. For application questions, we actually have to practice more to do well in examination.

Ryan: …for certain subjects like calculation, whether you like it or not, it is part of your job to make sure that you familiarise yourself with the subject because this is what you are supposed to do.

Zoe: For me, I memorised the facts for examination grades…

The above interview excerpts from research participants suggest that their primary purpose of learning was to pass tests and score good grades, although some of them did not explicitly express that their key objective was to excel in examinations. These findings concur with previous studies which suggested that students who were surface-oriented were inclined to focus on the extrinsic goal of meeting the course requirements (Evans et al., 2003; Gijbels et al., 2008; Rodriguez & Cano, 2007).

In sub-sections 4.1.1 and 4.1.2, most of the participants (for example, Adrian, Warren and Charles) were found to exhibit a strong interest in their program, but the results in this study showed that even these participants believed they learnt best through surface approaches. Such findings were inconsistent with Watkins and Akande's (1994) study where students who were intrinsically motivated and interested in learning tend to adopt deep learning approaches. For Ryan and Zoe, we know that a genuine interest in InfoComm Technology was not their primary reason for choosing to study it. As illustrated in 4.1.2, Ryan chose InfoComm Technology because he "*was tired of taking examinations and learning*" and "*wanted to do something different"* (interview excerpt, 8/12/2012), while Zoe took up InfoComm Technology because her father wanted her to do so. It could be for this reason that both of them appeared to favour surface learning approaches.

This finding is consistent with the literature, that is, students who have little intrinsic interest in learning will often adopt a surface approach (Watkins & Akande, 1994).

Although these participants adopted a surface approach, they did seem to be able to use the most appropriate learning approaches for the tasks. Thus, this may not have been their preferred approach so much as the approach they thought best suited the tasks they were given. For example, Adrian further stated that, *"It cannot just be lecturer-based teaching, where the teachers just teach and the students do not get to collaborate. In real life, students need some kind of collaboration…"* (interview excerpt, 2/10/2012). Warren felt that, *"For Mathematics, the traditional way is better. For other subjects, other methods will be better"* (interview excerpt, 18/09/2012). Similarly, Ryan also believed that *"For theory, you can learn it using technology, for example, an online quiz. For practical skills like driving a car or riding a bicycle, you actually need to do and feel it yourself in order to understand"* (interview excerpt, 8/12/2012). Warren, Ryan and Zoe also recognized that different approaches should be used for different subjects. For example, Zoe said, *"For Mathematics, you will have to practice but for business related subjects, you don't have to practice but you will have to think and think about the scenario…"* (interview excerpt, 3/2/2013).

These findings suggested that the participants might be surface learners much of the time, but were also able to identify that different learning approaches were necessary for different tasks. Such learning approaches could be due to the sophisticated notion of their domain-specific epistemological beliefs, where they were able to recognize where and when to obtain different knowledge for different domains (demonstrated in sub-section 5.1.6). In other words, the weighting between deep and surface approaches for learning was somewhat subject-dependent. As outlined previously, previous research had shown that students who used a surface approach lacked the ability to change their learning approaches to suit the demands of their learning tasks (Almeida et al., 2011). However, in this study, the participants did not exhibit a similar pattern. While these participants appeared to be surface learners, they were able to use the most appropriate learning

methods most suitable for the tasks. This could also indicate that their tendency for surface learning actually reflected the fact that such learning suited the learning tasks and learning environments in which they learnt.

5.3.2 Strategic approach – "reflective organising"

As postulated by Almeida et al. (2011), such a learning approach is largely influenced by examination or assessment. Therefore, students with this approach were more likely to work hard to obtain the best results and use the learning approaches that they believed would help them achieve their academic success (Dogan et al., 2012; Ling et al., 2011).

As already indicated above, in this study, all the participants appeared to adopt a strategic approach to some degree. The following statements illustrated how the participants were strategic about their learning approaches in or to achieve their goals in terms of getting good grades in a subject. For example:

> *Titus: I would put in extra effort...allocate more time for the weaker subjects, as in give time for consultation, revision and asking your peers…*

> *Nancy: When we are given an assignment, I will analyse the questions and come out with ideas. I will approach the lecturers and students to see what other exploration I can make and whether I can get any inspiration or any ideas from them.*

> *Adrian: Usually I will form study group with friends who are better at the subject. I will make my own notes, constantly revise them and try to memorise the key points.*

> *Isaac: …in order to stand out from the others, we have to show the examiner that we have put in effort and the thinking process.*

> *Annie: Actually I am more on the grade side, so I will just ask the lecturers for questions that are likely to be on the examinations.*

Henry: If it is a group project, the first thing is to pick good team mates…I will ask my lecturers to vet through first to see whether it is up to an A grade or not. If not, I will compare the project with my friends, to see if there is anything I can add in

Most of the strategic approaches adopted by the participants corresponded to the features identified by Almeida et al. (2011, p. 152), that is,

- Putting consistent effort into studying
- Managing time and effort effectively
- Finding the right conditions and materials for studying
- Being alert to assessment requirements and criteria
- Gearing work to the perceived preferences of lecturers

From the above interview excerpts, all the participants were very focused on practices that could improve their grades. For instance, Titus and Nancy would manage and plan their own study schedule. Annie, on the other hand, would seek cues from teachers as to what was expected for assessments. Isaac would do more than what was expected of him. Adrian and Henry would form a study group and carefully select their team mates. In addition, Henry and Nancy would also seek advice from their lecturers or check with their classmates to ensure that their work was on the right track. The approaches they took suggested that all these participants would "distribute their effort to greatest effect" to succeed (Lublin, 2003, p. 4). These findings were dissimilar to previously reported literature, where surface learners carry out only compulsory and essential tasks, for example, they would not attempt voluntary assessment related activities (for example, optional readings) and were largely depended entirely on lecture's notes (Almeida et al., 2011). As noted earlier in sub-section 5.2.2, the participants associated better grades with getting a good qualification, which in turn might lead them to a better job (Lee et al., 2007). In view of this, the take up of these learning approaches could be due to the participants' extrinsic aims.

However, I found that the participants embracing this strategic approach were not exclusively motivated by a desire to get good examination grades but they also seemed to aim for personal development and professional achievement. For instance, Titus would ask his *"lecturers for recommendations about the future, for example, how to get a better job, what qualification or requirements to get a good job, so that I can work towards the goals"* (interview excerpt, 4/11/2012). Like Titus, Annie also associated good grades with getting *"[into a] better school, better qualification and better job"* (interview excerpt, 18/9/2012). Nancy, who felt that learning is for personal growth, told me that, *"English can help in communication. If I am able to speak well, I will look more confident and I will also be more convincing… Mathematics trains the way to strategize something. Therefore, the things I learn in school will definitely come in handy in my work life"* (interview excerpt, 8/10/2012). Isaac, on the other hand, believed that he should *"learn some useful skills that I can use in the workplace"*. He also felt that it was *"kind of useless if the students are just going for the grades"* (interview excerpt, 23/9/2012). This, therefore, implied that most of the participants appeared to hold multiple and deep motives for learning. That is, they saw learning as personal development to further improve their overall skills level and abilities so that they can do their job more effectively.

In the next sub-section, I turn to examining the probable factors that might impact participants' learning approaches.

5.3.3 Possible factors influencing participants' approaches to learning

As mentioned earlier, the adoption of one's learning approach is likely to be influenced by personal factors (such as parental involvement, parents' educational achievement and personality traits) and situational factors (like classroom teaching and learning environment) (Malie & Akir, 2011; Kek & Huijser, 2011). The likely effect on participants' learning approaches shall be explored in the next few paragraphs.

The study found no association between participants' technology skills and the way they learnt. As discussed in sub-sections 4.1.1 and 4.1.2, the participants were adept in their technology skills, but mostly only simple and established technologies, such as the school's learning management system and mobile devices, were used for learning. For example, these technologies were used mainly for discussion, accessing and editing information and note-taking, as well as communicating with, and disseminating information to classmates, instead of as a collaborative learning tool.

Through analysing the interview data, other factors, such as the goals to be achieved, adapting to new environments, individuals' perceptions about the context and the demands of the workload, one's epistemological beliefs, conceptions of learning, teaching approaches as well as Asian culture were found to correlate with the participants' learning approaches to some degree.

Earlier in sub-section 5.3.2, it was noted that the participants' key purpose of learning was not only to attain good grades and a better job in the future, but they also saw learning as obtaining new knowledge to further develop their skills and achieve their goals in their career. As advocated by Karagiannopoulou and Christodoulides (2005), clear goals might influence how students learn. That is, students were more likely to take a deep approach to learning if they could see how their course of study was connected to their goals (Gijbels et al., 2008). Thus, this could explain why all the participants were able to identify and use the most appropriate methods to help them achieve their goals.

Some researchers believed that students who are adjusting to new learning environments and new demands, such as "heavy curriculum, work pressures" (Rodriguez & Cano, 2007, p. 650) tend to use surface approaches. Transitioning into a new school, the first year participants might be learning to deal with the academic and social pressures as well as acclimatising to their new surroundings. The final year participants, on the other hand, could be learning to cope with the heavy routine workload. This point is well illustrated by Ryan's comments, where he specifically

mentioned that "*If there is not enough preparation time, then I will memorise it and cram in as much information as I can… If time is not a factor, then I will take my time to learn and understand."* (interview excerpt, 8/12/2012). This might explain why both the first year and final year participants tend to use surface approaches. Besides, the interview data also lends support to the idea that time could be a critical factor. As stated above, Ryan would employ a surface learning approach, such as rote memorization, if he was constrained by time.

I also found that teaching approaches seemed to correlate with the participants' approaches to learning. Earlier, when I asked the participants how they were taught before they joined the Polytechnic, all of them shared with me the use of worksheets, whiteboards, conventional teaching methods and doing online quizzes (see sub-sections 4.1.1 and 4.1.2). As the participants were exposed to such "didactic variables" (Wang & Tsai, 2012, p. 616), they were more inclined towards using surface approaches. The findings in this study were similar to Streitwieser and Light's (2010) study, which reported that "transmission teaching approaches" (p. 347) were associated with surface approaches to learning, while teaching approaches that emphasized on the development of "conceptual change" (p. 347) were related to deep approaches.

While the participants might be engaging in surface approaches to learning, all of them seemed to adopt a strategic approach to some extent. As discussed earlier in sub-section 5.3.2, Isaac would put maximum effort into everything he did; Adrian and Henry would carefully select their team mates; Titus and Nancy would prepare her schedule while Annie would seek cues from teachers as to what was expected for assessments. Such learning behaviours could be influenced by several possible factors. First, as discussed in sub-section 5.1.6, the research participants were found to embrace some elements of the domain-specific epistemological beliefs, where they were able to change their learning approaches to suit the demands of their learning tasks. Second, the participants were also found to embrace aspects of the notion of learning as preparing for tests, where they adopted different learning approaches to help them achieve their academic goals (shown

in sub-section 5.2.2). Third, traditional Asian culture which stressed "effort, endurance and hard work" (Chan & Elliott, 2004, p. 827) might have also influenced the participants' adoption of an achieving approach, because students who were brought up in an Asian environment tended to have a greater desire to achieve more (Chan & Elliott, 2004; Liang et al., 2010; Zhu et al., 2008), thus were more inclined to work hard to obtain the best results, as mentioned earlier in sub-section 5.1.4.

5.4 Summary

In this study, several key findings were found. First, naïve epistemological beliefs did not seem to decrease as the first year participants advanced to their final year of study. Instead, it was found that all the third year participants continued to embrace many naïve epistemological beliefs. Second, there were also more first year participants with aspects of high level notions of learning than there were final year participants. Although all the participants appeared to embrace some aspects of constructivist-oriented epistemological beliefs and constructivist views of learning, they were found to have a greater preference for conventional, non-constructivist learning approaches and were less inclined towards a technology-based learning environment.

In this study, the participants' level of competency with, and use of, technologies did not appear to have shaped their epistemological beliefs and conceptions of learning. Regardless of the participants' level of ICT competencies (as illustrated in Chapter Four), they were found to embrace a combination of both naïve and sophisticated epistemological beliefs, both constructivist and reproductive views of learning and all seemed more inclined to use surface learning approaches, for instance, rote learning and repetition. This could mean that the participants' beliefs about knowledge and learning, as well as their approaches to learning, might be influenced more by other factors, such as teaching approaches and the learning environment they were exposed to.

The subsequent chapter provides a full discussion on each of the research questions. I now turn to answering and discussing each of the research questions in turn.

CHAPTER 6 DISCUSSION

This thesis described the epistemological beliefs, conceptions of learning and the learning approaches of twelve Singaporean Polytechnic students. I discussed the participants in terms of their technology skills, frequency of use of technology and their experiences of learning, and also asked questions about what they believed knowledge was, how they viewed learning and how they acquired their knowledge. I also explored the various factors that might impact their beliefs about knowledge, conceptions of, and approaches to learning.

As stated earlier, this study aimed to investigate how participants' use of technology influenced their epistemological beliefs, conceptions of, and approaches to learning. Therefore, to guide the study, the research questions were:

1. What is the extent and nature of Polytechnic students' use of technology for learning?
2. What are the epistemological beliefs surrounding learning with technologies among the post-secondary students, their conceptions of, and approaches to learning?
3. How does the students' use of technology influence their beliefs about knowledge, conceptions of, and approaches to learning?

I now focus on answering and discussing each question in turn to synthesise the findings of the study.

6.1 Research question one

What is the extent and nature of Polytechnic students' technology use for learning purposes?

This section synthesises the findings relating to the participants' technological competency, their use of, and frequency with which they used, technologies. The table below provides an overview of the skills possessed by the participants.

Table 5 – IT Proficiency

Participants who described themselves as	First Year Participants	Final Year Participants
Highly skilled	Adrian, Danny, Warren	Isaac, Zoe, Charles, Henry
Moderately skilled	Titus, Laura, Nancy	
Having basic skills		Annie, Ryan

These findings, as discussed in sub-sections 4.1.1 and 4.1.2, showed that the first year participants' technological competency ranged from moderately skilled in the use of established technologies to highly skilled in the use of both advanced and specialised technologies. There was no one from the first year group who described themselves as having basic skills. In view of this, the first year participants appeared to have better technology skills than the final year participants.

In this study, the participants who described themselves as being highly skilled not only had the skills necessary for most of the advanced technology-based activities (such as creating websites, developing applications and systems), but they were also equipped with different types of technological capabilities (like networking and troubleshooting skills) and demonstrated competency in the use of different technologies. Not surprisingly, this group of users also used technologies more frequently than the other students in the study. For example, all of them (except Danny and Warren) claimed to spend at least ten hours a day, exploring computers and developing applications for companies, during vacation.

In contrast, the participants who described themselves as being moderately skilled and as having basic skills were regular and basic users of established and core technologies. These participants tended not to engage in technology-based activities after school and their computer usage (for both personal and academic purposes) was lower than that of the other participants who reported being highly skilled. As illustrated in sub-sections 4.1.1 and 4.1.2, Titus and Laura preferred to spend most of their time with sports and games, while Ryan and Annie spent the least number of hours on a computer for both personal and academic purposes.

Earlier studies showed that there were some differences in how students used technology (Bennett & Maton, 2010; Brown & Czerniewicz, 2010; Kennedy et al., 2010a, 2010b). However, the results of my study showed that despite the differences in the participants' IT knowledge and skills, there was considerable similarity in the area of technological usage for social and academic purposes. For example, both the first year and final year participants enjoyed playing online games, watching online videos, sharing information with friends and classmates, socialising online, using social networking sites to keep track of friends, as well as searching for world news on the internet. The array of activities for academic learning was also found to be much the same amongst the two groups of participants. For example, they primarily used technology for discussion, research purposes, accessing and editing information, writing down notes, as well as communicating with and disseminating information to classmates. Although technologies (such as mobile devices, computers, and the internet) were used for learning, they were used mainly for quick communication and easy access to information.

6.2 Research question two

What are the epistemological beliefs surrounding learning with technologies among the post-secondary students, their conceptions of, and approaches to learning?

This section first describes the findings of participants' epistemological beliefs, followed by a summary of their conceptions of, and their approaches to learning.

6.2.1 Epistemological beliefs of first year and final year participants

The table below summarises the participants' epistemological beliefs.

Table 6 - Epistemological beliefs embraced by the participants

Categories	Continuum	Description	First Year Participants	Final Year Participants
Simplicity of knowledge	Sophisticated	Knowledge as highly interrelated concepts	Warren, Adrian, Nancy, Titus, Laura	Charles, Annie, Isaac, Ryan, Zoe, Henry
	Naive	Knowledge as isolated bits and pieces	Danny	None of the participants
Omniscient Authority	Sophisticated	Knowledge being derived from reason	None of the participants really, fully, exhibited this view	
	Naive	Knowledge being handed down by authority		
Certainty of knowledge	Sophisticated	Knowledge as evolving and fallible	Nancy, Danny, Adrian, Laura	Henry, Zoe
	Naive	Knowledge as absolute	None of the participants	Annie
Innate Ability	Sophisticated	Ability to learn is developed over time	Danny, Laura, Nancy	Ryan, Zoe, Henry, Charles, Isaac
	Naive	Ability to learn is inborn	Titus, Warren	Annie
Quick Learning	Sophisticated	Learning occurs gradually	Adrian, Nancy, Laura, Danny	Charles, Isaac, Ryan, Zoe, Henry
	Naive	Learning occurs quickly or not at all	None of the participants	
Domain-specific Knowledge	Sophisticated	Knowing how, where and when to obtain certain facts or utilise specific procedures	Warren, Adrian, Nancy, Titus, Laura, Danny	Charles, Annie, Ryan, Zoe, Henry
	Naive	Use same learning approaches for all/most subjects	None of the participants	Isaac

From the data, it appeared that all participants were found to embrace a complex combination of both naïve and sophisticated epistemological beliefs that were often highly context dependent. These findings were in line with prior research findings, suggesting that one could simultaneously maintain a mixture of both notions of knowledge and knowing but, at any given time; one type of belief might be more dominant than the other (Schommer et al., 1997; Brownlee et al., 2009). This supports the notion of epistemological beliefs being context dependent because

the sorts of epistemological beliefs students held could differ depending on the context, especially the subject area (for example, Mathematics and History).

Schommer (1993) postulated that students' epistemological beliefs changed significantly during their transition from first year to their final year of study, generally becoming more advanced. However, the findings from this study were not consistent with this claim. Although this was not a longitudinal study of the same group of students, a comparison of the two groups of students suggest that naïve epistemological beliefs did not appear to decrease as first year students progressed to the final year of study. Instead, it was found that all the final year participants in this study continued to embrace some naïve epistemological beliefs. For instance, some participants seemed to believe in aspects of knowledge as fixed and certain, as emanating from omniscient authorities or in the notion of quick learning. Since this finding is based on a comparison of two different (and small) groups of students, I cannot be certain that the final year students in this study were not just a group that were prone to some naïve beliefs in general. Further evidence for this finding would require the tracking of the same cohort of students throughout their study to determine whether, and how, their epistemological beliefs changed.

The epistemological beliefs embraced by the first year students were not found to be less sophisticated than the final year participants. That is, many first year participants were found to embrace more sophisticated epistemological beliefs. For example, many of them viewed knowledge as consisting of interrelated concepts, believed in tentative knowledge, and that learning was developed gradually over time as opposed to being innate. Previous research has shown that sophisticated epistemological beliefs were usually held by individuals at the end of their program of study. However, in this study, they were demonstrated by first year participants.

Previous studies had found that students with constructivist beliefs were less dependent on authorities for information (Brownlee et al. 2001). Findings in this study showed that regardless of whether their epistemological beliefs were otherwise naïve or sophisticated, and regardless of their

age, all the twelve participants considered the presence of teachers as essential elements for learning (Wang & Tsai, 2012). That is, they trusted the views of experts to some degree and generally considered them to be a reliable and important source of information. However, most also described a willingness to go beyond the views of teachers or experts and seek out further information and integrate ideas from various sources. None of them fully exhibited a total reliance or uncritical acceptance of the views of authorities, like teachers.

First year participants preferred to initially look to their friends first, instead of lecturers, for assistance. However, this appeared not to be the case for the third year participants. From the data shown in sub-section 5.1.2, it was possible that the traditional Asian culture which emphasises "respect and obedience" for authorities (Zhu et al., 2008, p. 414), including within academic contexts, has stronger effect on the first year participants, who seemed more wary of approaching lectures for assistance in the first instance.

6.2.2 Learning conceptions of first year and final year participants

The table below shows an overview of the learning conceptions embraced by the participants.

Table 7 - Learning conceptions embraced by the participants

Categories[2]	**Description**	**First Year Participants**	**Final Year Participants**
High Level Conceptions of Learning			
Learning as applying based on understanding	Learning as applying new information and understanding	Warren, Adrian, Nancy, Titus, Laura, Danny	Charles, Zoe, Ryan, Henry
Learning as an interpretative process aimed at the understanding of reality	Learning within this conception helps one to discover a better way to view and interpret the world around them in new ways	Adrian, Nancy	None of the participants
Learning as changing as a person	Learning as personal transformation	Laura, Nancy, Adrian, Titus	Ryan, Charles, Zoe

[2] The categories, shown in the table above, are not in order of hierarchy.

Categories[2]	Description	First Year Participants	Final Year Participants
Low Level Conceptions of Learning			
Learning as memorizing	Learning as memorization and storage of definitions, equations, procedures and terms with the primary purpose of reproducing it for examinations	Adrian, Laura, Nancy	Ryan, Henry
Learning as preparing for tests	Learning as studying and achievement on assessment tasks	Danny, Warren, Titus, Laura	Annie, Ryan, Henry, Charles
Learning as drill and practice	Learning through repetitive practice and reinforcement	Warren, Adrian, Nancy, Titus, Laura, Danny	Charles, Ryan, Zoe, Henry, Isaac
Learning as the increase of simple knowledge	Learning as the acquisition and accumulation of discrete pieces of information	Warren, Adrian, Nancy, Titus, Laura, Danny	Charles, Ryan, Henry, Isaac
Learning in terms of didactic instruction	The presence of teachers and conventional teaching approaches are viewed as essential elements for learning	Warren, Adrian, Nancy, Titus, Laura, Danny	Charles, Annie, Isaac, Ryan, Zoe, Henry

All the twelve participants were found to possess multiple conceptions of learning that appeared to be heavily context dependent, especially subject-dependent (Chiou & Liang, 2012). For example, the participants might view learning as involving gaining real understanding in some disciplines but as consisting of drill and practice in others.

Additionally, there also seemed to be more first year participants with aspects of high level conceptions of learning than there were final year participants. For example, most of the first year participants believed learning not only involved aspects of changing as a person but also involved a degree of applying and understanding. This could imply that the first year participants were more likely to relate learning to practice and the 'real world' (Eklund-Myrskog, 1997), thus, seemingly displaying a higher level of learning than the final year participants. From the findings, epitomized in section 5.2, third year participants embraced various naïve views of learning, such as aspects of the drill and practice conception of learning and learning as preparation for tests. Therefore, the

results of this study appeared to be in contrast to a common assumption that students at the end of a course tended to embrace more advanced views of learning (Eklund-Myrskog, 1997).

All the first and final year participants, regardless of their naïve or sophisticated epistemological beliefs, often associated learning with didactic instruction. In other words, they expressed a preference for conventional teaching modes, such as teacher-centred pedagogy, and technology used as a repository of information, rather than student-centred, collaborative, discussion or inquiry based learning methods or use of technology. Even when technologies were used by the participants, it was primarily used as a tool for communicating with teachers and students and for accessing course content but not really as a tool for collaborative, constructivist learning. These results are inconsistent with those obtained by Tsai and Chuang (2005), Tu et al. (2008), as well as Dillon and Gabbard (1998). In their studies, students with more sophisticated and constructivist-oriented epistemological beliefs had higher preferences for constructivist technology-based learning environments or for using digital tools to explore information in an in-depth, critical manner. This study showed no connection between conceptions of learning and IT skill levels.

6.2.3 Learning approaches of first year and final year participants

The following table summarises the learning approaches employed by the participants.

Table 8 - Learning approaches used by the participants

Types of Approaches	**Description**	**First Year Participants**	**Final Year Participants**
Surface	Learning without reflecting on either purpose or strategy	Warren, Adrian, Laura, Danny	Charles, Annie, Isaac, Ryan, Zoe, Henry
Strategic	Learning largely influenced by examination or assessment	Warren, Adrian, Nancy, Titus, Laura, Danny	Charles, Annie, Isaac, Ryan, Zoe, Henry

Unlike Wishart's (2005) and Liang et al.'s (2010) findings, where students in the Computer Science program were more inclined to use deep approaches and preferred technology-integrated

learning environments, the results of my study showed otherwise. Although the participants appeared to embrace some aspects of constructivist-oriented epistemological beliefs and elements of high level conceptions of learning (exemplified in sections 5.1 and 5.2 respectively), they were also found to adopt many conventional, non-constructivist notions of, and approaches to, learning, such as a focus on note taking and a "more direct instructional style" (Ravert & Evans, 2007, p. 326). Although most of the participants' technological competency ranged from moderately skilled to highly skilled, they did not show greater preferences towards digital learning. Instead, many of them tended to view technology primarily as a repository of ready-made information rather than as a collaborative and constructivist learning tool (as stated earlier). Like epistemological beliefs and conceptions of learning, the findings in this study showed no clear relation between the conceptions of, and approaches to, learning and ICT skill levels.

Furthermore, all the participants described having surface learning tendencies to some extent and their learning motives were found to be relatively homogeneous. Not only did many of them view learning as focused on attaining high scores, but they also believed that good academic scores could lead them to better colleges and better careers in the future. With respect to this, the participants used learning methods that they believed would help them achieve their goals and were also more likely to put in additional effort to obtain the best results (Dogan et al., 2012; Ling et al., 2011). These findings were different from prior studies which postulated that surface learners carried out only essential tasks and lacked the ability to change their learning approaches to suit the demands of their learning activities (Almeida et al., 2011). These participants seemed to be more strategic, in that, the ways in which the participants learn could happen through deep or surface approaches depending on the context and demands of the tasks they had been set (Dogan et al., 2012). The findings of this study indicated that when the students used a surface approach in learning it was often because they believed such an approach suited the task or subject. Thus, the

use of surface learning approaches was not necessarily an indication that they were not be able to identify and select the most appropriate learning approaches for themselves.

6.3 Research question three

How does the students' use of technology influence their beliefs about knowledge, conceptions of, and approaches to learning?

Thus far, I have looked in detail at the different levels of technological expertise one possessed; the epistemological beliefs, learning conceptions and learning approaches one embraced. I now turn to discussing the influence of the participants' level of technological expertise and their use of technology on students' learning.

6.3.1 Relationship between students' use of technology and their beliefs about knowledge

The data suggested that the level of technological expertise correlated, to some extent, with the epistemological beliefs of some participants. For example, Adrian, Danny, Warren (first year participants), Isaac, Zoe, Charles and Henry (final year participants) had the skills required for most of the advanced technology-based activities (such as creating websites, developing applications and systems) and were equipped with different types of technological capabilities (like networking and troubleshooting skills), as illustrated in sections 4.1 and 6.1. These activities presumably involved some form of higher order analytical, reasoning and judgment making skills. As stated in the literature review, sophisticated beliefs were positively related with higher order thinking skills (Chai et al., 2009a). Therefore, it was possible that the high-order technology-based activities that the students were engaged in were indication of their advanced epistemological beliefs. However, there is no reason to believe that a less advanced use of technology is an indication of naïve epistemological beliefs. For example, earlier in sub-section 4.1.1 and section 6.1, it was noted that Titus, Laura and Nancy were relatively low users of technologies and merely embraced the required

skills necessary for administrative tasks. However, despite their lower level of technology fluency, they were found to possess many sophisticated epistemological beliefs. This could mean that relationship between technology use and skills and epistemological beliefs and conception of learning was limited.

In this study, the learning environment and teaching approaches did appear to be key determinants influencing the naïve and advanced epistemological beliefs of the participants. Their simple and advanced epistemological beliefs often did appear to reflect the teaching approaches employed by their lecturers. For example, as discussed in sub-section 5.1.7, Charles' naïve epistemological beliefs, such as a perception of knowledge as largely fixed and certain, reflected the more teacher-directed approach which he said he was often exposed to. For example, he mentioned that during his secondary school days, learning often consisted of being given lots of written exercises for practice. Such repeated and habitual practice might lead Charles to think that memorization and drill is important for learning, which in turn might influence him to think that knowledge is fixed. On the other hand, Nancy's advanced epistemological belief that knowledge is generally tentative and interrelated, could be due to her exposure to the range of different teaching approaches which she described her lecturers were using, such as a mix of presentations and learning activities involving use of the internet and flash animation. The use of the various teaching methods might encourage her to depend on multiple sources rather than a single source for information.

Additionally, traditional Asian culture and one's interests were also found to play an important role in the development of the participants' advanced epistemological beliefs. Given that Asian students are brought up in a traditional environment, most of the participants did not believe in quick learning and innate ability, were more likely to take ownership of their own learning and also more willing to put in effort and time to obtain the best results (as explained in sub-sections 5.1.4 and 5.1.5). Furthermore, such beliefs could also be shaped by the participants' interest in the

program. Earlier, most of the participants were found to exhibit a strong interest in their program of study. This might explain why they were more willing to put forth effort in learning that is, having more practice sessions in order to excel in examinations.

In the light of these findings, it might suggest that one's technology use does not shape their epistemological beliefs to any significant extent, that is, one may hold either advanced or simple beliefs (or a combination of both) regardless of their level of technology fluency. A student could be a surface user of technology but it might not necessarily imply that he/she would embrace only naïve epistemological beliefs. Given the small number of research participants, it cannot be assumed that this applies to all Polytechnic students or even Singaporean students. Further research is needed to explore this theme.

6.3.2 Influence of students' use of technology on their learning conceptions

The findings in sub-sections 4.1.1 and 4.1.2 as well as section 6.1, showed that most of the participants were adept in using a wide variety of technologies. However, their expertise with technologies did not seem to have a direct effect on their conceptions of learning. For example, they did not see the importance of the use of technology in the classroom, but rather they viewed learning as involving didactic instruction and preferred conventional teaching modes. This could be shaped by how teaching and learning activities were conducted. As illustrated earlier, all participants were predominantly exposed to conventional and non-constructivist notions of learning approaches, such as repetitious practices, as well as a lecturing style of teaching. Such frequent exposure to conventional teaching might explain why the participants developed low level conceptions. Some examples of reproductive conceptions include memorizing facts, preparing for examinations, drill and practice, as well as regarding learning as didactic instruction.

It was also possible that Asian culture (which emphasizes hard work), one's interest in the program and one's epistemological beliefs, could be the factors for shaping their conception that

quality learning should comprise drill and practice. As a result, they were more willing to put in effort and work hard to excel in examinations, demonstrated in sub-section 5.2.9.

Based on the discussion above, it appeared that the participants' level of technology fluency did not shape their learning conceptions to any significant extent. Instead, other factors, like classroom teaching (that is the use of didactic variables), epistemological beliefs, culture and one's interest in the program, were found to be common factors that might have an effect on how the participants viewed learning.

6.3.3 Influence of students' use of technology on their learning approaches

In a number of studies conducted by Liang et al. (2010), Rodriguez and Cano (2007), as well as Zhang and Sternberg (2000), it was believed that as students grew older and as they progressed in their studies, they were more inclined to use deep learning strategies and less surface approaches for learning. However, the findings of this study revealed that all participants, regardless of age, seemed to use surface approaches to some extent. As discussed in sub-section 5.3.3, such conflicting results could be due to (a) one's adaption to new learning environments and new demands, (b) Asian culture, and (c) teaching approaches.

Besides the use of surface approaches, the participants were also found to adopt achieving approach to some degree. It was cited earlier (in sub-section 5.2.2) that the adoption of these learning approaches could be due to their extrinsic aims or their pragmatic attitudes, that is, attaining good grades, getting a better job and obtaining new knowledge to further develop their skills.

While most of the participants described themselves as highly skilled, it was not clear that they ever used digital tools for collaborative and constructivist learning, as discussed in sub-sections 4.1.1 and 4.1.2 as well as sub-section 6.2.3. Therefore, like the other two constructs, the data, as discussed above, implied that the participants' learning approaches were more likely to be

influenced by other factors. In other words, there was no direct association between participants' technology skills and how they approached learning.

The next chapter provides some possible implications of the study which are perceived as both beneficial and important for the instructional designers, teacher educators, educational researchers and educational policy makers. Limitations of the study and areas for further research are also explored.

CHAPTER 7 CONCLUSION

Prior studies have revealed the importance that beliefs about knowledge have on the effectiveness of educational practices (Gurcay et al., 2013; Lim & Chai, 2008). For instance, one's epistemological beliefs may have an influence on the different aspects of learning, that is, ones' beliefs about learning and how one may approach learning (Brownlee et al., 2009; Cano, 2005; Chai et al., 2011; Liang et al., 2010). While epistemological beliefs may have an effect on the conceptions of, and approaches to, learning, students' use of technology (in terms of their IT skill levels, as well as their access to, and use of technologies) may also have an impact on these constructs. This claim is reinforced by Demirbilek (2014), who argues that media technology could influence how one thinks, acts and learns. Therefore, the examination of the relationship between students' use of technology, their beliefs about knowledge and learning and their approaches to learning is worthwhile because students' technology use may have an effect on the epistemological beliefs they embrace, and hence affect how they view and approach learning.

As an instructional designer, my responsibility is to design curriculum materials for students to enhance their learning experiences. Understanding the relationships amongst these various constructs not only gives me greater insights into the participants' use of ICT, their beliefs about, and approaches to learning, but it also helps me to design a more favourable learning environment to foster critical thinking amongst the Polytechnic students. Hence, I was particularly interested in how Polytechnic students' use of ICT influenced the various elements of learning. In light of this, the research study aims to examine Polytechnic students' technology use, their beliefs about knowledge and learning as well as how they approach studying.

In this study, several key findings emerged. They are: (a) the participants' level of technology fluency was not homogenous; (b) all the participants were frequently exposed to various types of conventional teaching methods; (c) some common approaches to learning were utilised by both groups of students, specifically all the participants were found to adopt conventional, non-

constructivist approaches to learning at least some of the time; (d) additionally, despite being raised amid a wide variety of digital technologies, there were students from both cohorts who showed some preference for more traditional teaching methods, as opposed to technology-based learning environments; (e) some students reported only a limited, and rather superficial, use of technology by educators (for example, posting lectures and other materials online); and, (f) contrary to expectations, a tendency for naïve epistemological beliefs did not necessarily appear to decrease as students progressed to senior years. Both naïve and more sophisticated epistemological beliefs were found amongst both first year and third year students. Findings suggested that the evolution of technologies played a noteworthy role in the student's social life or leisure time, such as how one lives and communicates, but there was no clear evidence that technologies had significantly transformed the student's beliefs about knowledge and learning or their approaches to learning within a formal education setting.

7.1 Implications for future practice

As indicated earlier, learning in the 21st century is thought to be more about "knowledge building", "meaning making", "active and participatory learning" than simple acquisition of established knowledge (So et al., 2009, p. 368). Therefore, to succeed in this complex and rapidly changing society, students in Singapore must be developed into learners with higher-order thinking skills like critical and creative thinking and the application of knowledge to real world problems. It is essential for students to be able to think and analyse critically, apply their knowledge to new and complex situations, seek creative solutions to problems that cannot be solved simply by applying existing knowledge, as well as develop and use technology so as to support such higher order thinking and problem solving activities. The learning of such '21st century capabilities' can be achieved with the support of the effective use of ICT in schools (Lim, 2007). The recommendations

discussed below might provide some guidelines to support the development of higher learning conceptions and more sophisticated epistemological beliefs.

First, educators and instructional designers need to design and implement activities, which focus on learner autonomy, knowledge-building and the inquiry process, to help students develop higher order thinking skills, become "lifelong learners" (Lim, 2002, p. 411), "independent and self-regulative learners" and creative problem solvers (Klatter et al., 2001, p. 485). In addition, teachers should also be mindful that students' learning depends on their beliefs about knowledge and learning (Cano & Cardelle-Elawar, 2004). Thus, it is important to foster, amongst students, more sophisticated epistemic beliefs and beliefs about learning. Constructivist learning experiences are more likely to shift one's epistemological beliefs to become more constructivist-oriented and advanced (Hong & Lin, 2010). Therefore, the nature of teaching and learning should be re-designed based on constructivist-oriented pedagogies (Wang & Woo, 2009; Laurillard, 2008; Lee & Tsai, 2005), rather than simply led by what technology can do and provide.

Second, studies show that a teacher's belief about teaching has a significant effect on how teaching and learning will occur in a classroom (Chan & Elliot, 2004; Teo, Chai, Hung & Lee, 2008). This notion is further supported by Kek and Huijser's (2011) and Zhu et al. (2008) studies in which classroom teaching is significantly related to one's beliefs and views about learning. However, it was found that a belief in constructivist teaching can be both "positively correlated with constructivist use of technology" and "significantly correlated with the traditional use of technology" (Teo et al., 2008, p. 170). This could be due to technology skills. That is, even where teachers usually adopt constructivist approaches to teaching, a lack of technological know how may inhibit their ability to apply this to their use of technology in the classroom. To discourage teachers from using technology in a traditional way, teachers could be supported, such as through mentoring or professional development opportunities, to design learning materials and activities that foster more constructivist forms of teaching. In other words, a buddy system could be adopted whereby a

teacher who has higher ICT competence, is paired up with a teacher with lower ICT competence so that the former can support or assist the latter in creating a learning environment which engages students in higher-order thinking while using technology (Lim, 2007). Additionally, it is also essential to help the teachers, especially the new teachers, to understand the significance of using technologies with constructivist strategies. That is, when technology tools are used appropriately, they can "engage students in higher-order type of thinking" (Lim, 2007, p. 111) and such high level views of learning were found to be positively related to better learning outcomes (Peterson et al., 2010).

Third, more professional development activities are needed to help facilitate the change. As posited by Callum and Jeffrey (2013), teachers would be more likely to adopt technology if they perceive technology to be easy to use and have confidence in the technologies to work reliably and effectively. Hence, it is important to build up teachers' interest and confidence in using technology for teaching. To support the ease of use and increase the willingness to use technologies, there could be sharing sessions to exhibit good ICT-mediated lessons, updates on the current trend of technologies, and demonstrations of effective use of technology in the classroom (Lim, 2007). Besides enhancing their ICT experience, general pedagogy focused professional development is also critical to provide good scaffolding for educators to implement appropriate technology based pedagogy (Jamieson-Proctor, Redmond, Zagami, Albion & Twining, 2014).

One of the challenges faced by teachers seeking to incorporate ICT in the classroom was the lack of support (Redmond & Albion, 2002). Therefore, to encourage educators to use technologies to teach, Albion et al. (2010) advocated that as "staff experiences of new ICT are limited" (p. 34), it is also important to assure that when preparing and delivering technology in their lessons, educators should be adequately supported in their technology needs, including with support staff and instructional materials. That is, they should have a support team and resources to assist them, especially those who are unfamiliar with technology. The support team, which would consist of

teachers, instructional designers and IT support staff, would work with the educators to ensure smooth implementation of technology.

7.2 Limitations

First, the study is restricted by a relatively small sample size and the findings are based on a comparison of two different (and small) groups of students. Therefore, the final year participants who were found to embrace many simple epistemological beliefs might generally be just a group that were more inclined to naïve beliefs. In view of this, a similar study with a larger sample size could be considered for future study.

Second, this study only included participants from the InfoComm Technology program; thus, the results might not be easily generalized to students in other programs. As disciplines or domains of study were correlated to the beliefs about knowledge and approaches to learning (Jarvis & Woodrow, 2001; Marra & Palmer, 2008), further investigation of different programs could be carried out. To address the generalizability of the findings, I would include students from the different schools, for example, School of Humanities and Social Sciences, School of Engineering and/or School of Business and Accountancy.

Third, it should be noted that this study relied on self-reporting, and the drawback of this method is that participants may report differently from their real-life practices. Thus, future study could include using multiple approaches (such as interviews, observations of actual students' learning and observations of actual classroom teaching) in combination with self-report, to achieve greater validity and accuracy of data. By providing a more holistic understanding of the relationships amongst the various constructs, it would overcome the limits of self-reporting.

Additionally, research literature not only reported that parents' educational achievement had an effect on students' use of learning approaches (Biggs, 1987; Kek et al., 2007; Kek & Huijser, 2011; Marjoribanks, 1996), but it was also found that learning outcomes were associated with

epistemological beliefs, conceptions of, and approaches to learning (Kek & Huijser, 2011; Lin & Tsai, 2009; Peterson et al., 2010). However, due to the sensitivity of information (like parents' educational background and participants' academic results), such information could not be obtained easily. The absence of this information was another limitation which had restricted me in assessing the relationships amongst these constructs. As a result, these areas were not explored in this study.

7.3 Areas of further research

This study is not without limitations, but even taking the limitations into consideration, the findings (i) add significant value to our understanding of students' learning in Polytechnic education in Singapore and (ii) serve as a valuable starting point for further research, suggesting various themes that warrant further investigation. Besides conducting a similar study with a larger sample size, including students from various schools and using multiple data collection methods and methodological approaches, the following suggestions should also be considered for future research.

Prior literature revealed that one's learning preferences and behaviours (especially in ways related to formal education) could be influenced by their proficiency in using a wide range of digital technologies (Bennett & Maton, 2010; Kennedy et al., 2007). However, the results of this study did not clearly support this. Thus, further research into the impact of technology use on conceptions and approaches to learning (such as using larger sample size and a range of students from the various schools) should be undertaken.

Besides age and fields of study (that is, participants from different level of education and different schools), it would be of theoretical interest to investigate whether the same pattern of relationships amongst the various constructs (that is, students' usage of technology, their epistemological beliefs, learning conceptions and approaches) are replicable in students of different gender, cultures and socioeconomic status.

At present, the participants' technological expertise, their use of technology and how their lecturers teach in the classroom were based on participants' perceptions. As indicated in sub-section 7.2, such self-reporting data might not be the same as actual behaviours. However, as observations of students and lecturers were not conducted, I was unable to triangulate this data. Therefore, in a future study, observations of actual students' learning and observations of actual classroom teaching could be conducted to find out how the participants use technology in their daily life – both in and outside class as well as the types of teaching approaches adopted by the lecturers.

This study investigated a sample of first year and final year students. Their use of technology, beliefs about knowledge and learning may change as they progress through educational experiences (Callum & Jeffrey, 2013; Loyens et al., 2008; Brownlee et al., 2009). It might be useful for future studies to track the same group of students throughout their study to examine if, and how, their use of technology, their beliefs, and views of learning changed as they advance through their program of study. In this regard, a longitudinal study would be worthwhile.

7.4 Concluding comments

In today's digital world, work has not only become more "knowledge-based, interdisciplinary and complicated" (Wang & Woo, 2009, p. 191), but many organizations in various industries are also looking for "new literacies practices" (Lim et al., 2010, p. 204) to improve work efficiency (Goh et al., 2010). Therefore, to be successful in the social, academic and workforce aspects of lives, it is crucial that the current Net Generation develop higher order thinking skills (Lambert & Cuper, 2008; McCoog, 2008; State Educational Technology Directors Association [SETDA], 2011), become "lifelong learners" (Lim, 2002, p. 411; Beckett, 2000), and "independent and self-regulative learners" (Klatter et al., 2001, p. 485). In view of this, it is necessary to teach with and through technologies to prepare and equip students with the necessary knowledge and skills needed for success in this fast changing world (Redmond & Albion, 2002).

Following this line of thought, a meaningful learning environment which promotes constructivist-oriented pedagogies is necessary because such an environment is found to result in more sophisticated beliefs about knowledge and learning (Chai et al., 2009; Gerjets & Hesse, 2004; Teo et al., 2008; Tsai, 1999). However, it is dangerous to depend on the generalised assumptions or claims about the characteristics of the Net Generation, their beliefs, skills and use of technology, as the basis for developing educational goals. A greater knowledge of these variables is therefore essential to help educators and instructional designers to make informed decisions regarding the use of technology in support of constructivist teaching.

Given that in this study the participants' frequent exposure to conventional teaching appeared to be a key factor influencing their beliefs, views about, and approaches to learning, I conclude that there is a need to find ways to encourage constructivist-oriented use of ICT to foster sophisticated epistemological beliefs and advanced learning conceptions. For example, it may be useful to continuously evaluate and reflect on the teaching practices. As posited by Lim, Hung, Wong and Hu (2004), "the amount of implicit knowledge picked up through participation in a culture" (p. 44) is immense and cannot be underrated, that is, students tend to frame their own views of learning by observing how the lectures are conducted and delivered in the classroom. Earlier studies showed that ICT skills-confidence relationship (Callum & Jeffrey, 2013) and pedagogically focused professional development (Jamieson-Proctor et al., 2014) are important to the use of technologies in the classroom. For this reason, it is necessary to provide continual professional growth opportunities for academic staff in these areas.

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APPENDIXES

Appendix A - Email to the Director of School of InfoComm Technology and lecturers requesting their assistance to recommend suitable participants for the study

Dear Dir/ICT,

My name is Toh Bee Peng and I am currently doing a doctoral research study, titled "The influence of post-secondary students' technology use on their epistemological beliefs, conceptions of and approaches to learning", with my supervisor Dr Nicola Johnson, a senior lecturer in the Faculty of Education at the Monash University.

In this research, I wish to find out how students use technologies in their everyday life, what learning means for the individual students and what their preferred study approaches are. In order to find out students' experiences with technology and how it links to learning, I would like to interview six ICT students from Year 1 and Year 3 respectively. Their participation will add to and provide further understandings of how each individual student learns, thus enabling teacher educators to modify their teaching strategies to suit the learning styles and needs of the net generation. Participation is voluntary and all data will be kept anonymous and confidential at all times. There are no foreseeable risks associated with this study. At the end of the project, a totally de-identified summary result will be forwarded to ICT and to the participants, if they request the results.

What does it involve?

- The study involves semi–structured interviews, with audio taping. Prior to the interview, a list of questions will be sent to the participants. They can prepare the answer in advance if you wish to and they can also choose not to answer any questions during the interview.
- The interview will be an hour long for each participant.
- The interview will be conducted during teaching weeks and at a mutually convenient time.

I would like to seek your approval to interview the ICT students. Your support and approval is sought, thank you. If you give permission for this research to be conducted, please could you send me an official letter of approval on letterhead as Monash University Human Research Ethics Committee requires this documentation.

If you have any questions regarding this study, feel free to email me at [redacted] I would be happy to provide any information you may require. Thank you for your assistance.

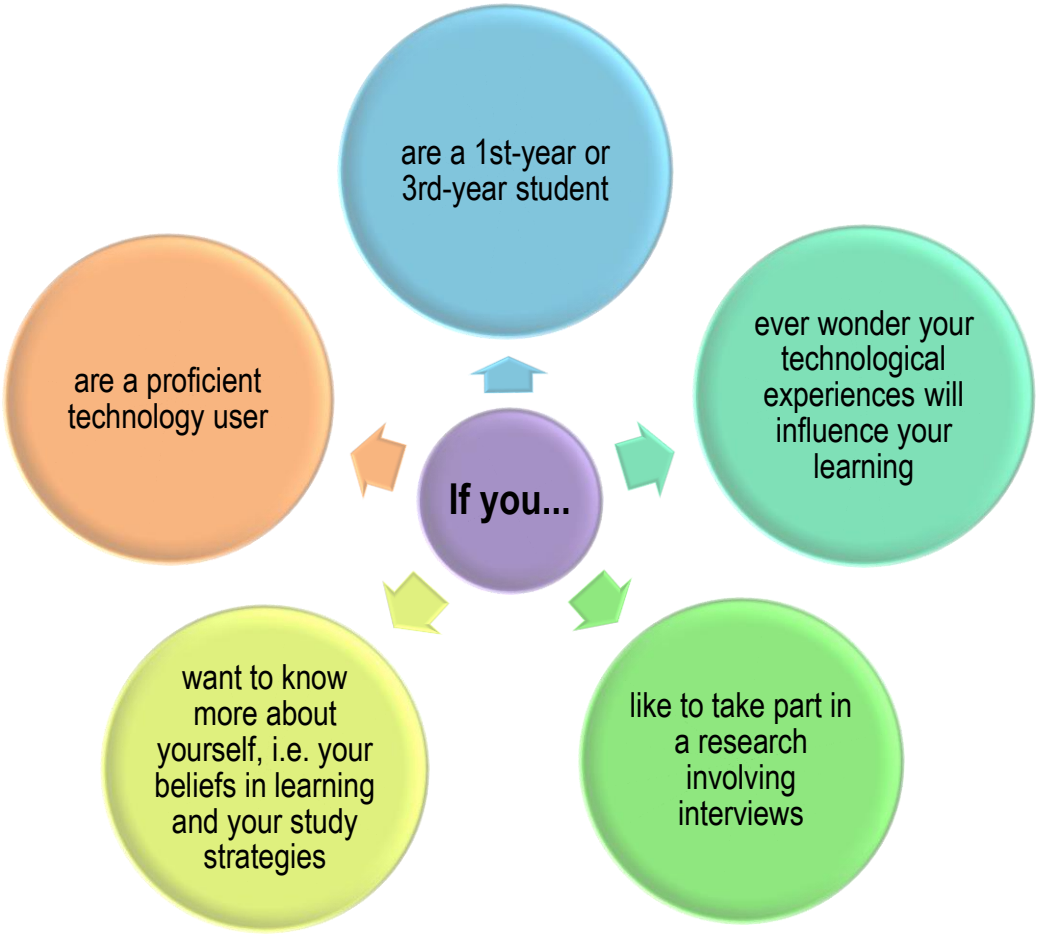
Sincerely,

[redacted]

Diana Toh

Appendix B – Poster to place on the school noticeboards

PARTICIPANTS REQUIRED FOR RESEARCH IN STUDENTS' LEARNING



WE WOULD LIKE TO HEAR FROM YOU!

To volunteer for this study or for more information, please contact:

- **Diana Toh**
- [redacted]
- [redacted]

This research is conducted by Diana Toh, currently doing a doctoral research study with my supervisor Dr Nicola Johnson, a senior lecturer in the Faculty of Education at the Monash University.

This study has been reviewed and approved by the Research Ethics Committee at Monash University, CF12/0695 - 2012000299.

Appendix C – Introductory emails

(i) Introductory email to Year 1 students taking part in the study

Dear _____,

Thank you for expressing interest in my research study and giving me this opportunity to write to you.

My name is Diana Toh and I am a doctoral student in the Faculty of Education at the Monash University, Australia. I am currently doing a research study with my supervisor Dr Nicola Johnson, a senior lecturer in the Faculty of Education at Monash University. In this research, I wish to find out how students use technologies in their everyday life, what learning means for the individual students and their approaches to studying.

As an Instructional Designer in the Polytechnic, I work with lecturers from the different schools to design effective instructional materials for teaching and learning. Therefore it is essential for me to understand how each student learns, so as to design and develop teaching strategies to suit the learning styles and the needs of the net generation. In order to find out students' experiences with technology and how it links to learning, I would like to interview you.

What does it involve?

- Participation is voluntary.
- The study involves semi–structured interviews, with audio-taping. The purpose of semi-structured interview is to gain in-depth understanding of how students use technologies in their everyday life, what learning means for the individual students and their approaches to studying.
- Prior to the interview, a list of questions will be sent to you. You can prepare the answer in advance if you wish to and you can also choose not to answer any questions during the interview.
- The interview will be an hour long for each participant.
- The interview will be conducted in one of the meeting rooms at my office, during teaching weeks and at a mutually convenient time.
- The findings will be completely anonymous. Your real identities will not be disclosed in any reports and will be kept confidential through the use of pseudo names. No demographic details, except for gender and year of study will be reported. All recorded interviews and transcripts are only accessible to my supervisors and me.

This study has been reviewed and approved by the Research Ethics Committee at Monash University. I am attaching the Explanatory Statement and the consent form. Please read the Explanatory Statement in full before making a decision. If you are interested in taking part in this study, could you sign and email the consent form to me within one week's time.

Your participation would be greatly appreciated. If you have questions about the study or participation, please email me at [redacted]

Thank you.

[redacted]
Toh Bee Peng Diana

(ii) Introductory email to Year 3 students taking part in the study

Dear _____,

Thank you for expressing interest in my research study and giving me this opportunity to write to you.

My name is Diana Toh and I am a doctoral student in the Faculty of Education at the Monash University, Australia. I am currently doing a research study with my supervisor Dr Nicola Johnson, a senior lecturer in the Faculty of Education at Monash University. In this research, I wish to find out how students use technologies in their everyday life, what learning means for the individual students and their approaches to studying.

As an Instructional Designer in the Polytechnic, I work with lecturers from the different schools to design effective instructional materials for teaching and learning. Therefore it is essential for me to understand how each student learns, so as to design and develop teaching strategies to suit the learning styles and the needs of the net generation. In order to find out students' experiences with technology and how it links to learning, I would like to interview you.

What does it involve?

- Participation is voluntary.
- The study involves semi–structured interviews, with audio-taping. The purpose of semi-structured interview is to gain in-depth understanding of how students use technologies in their everyday life, what learning means for the individual students and their approaches to studying.
- Prior to the interview, a list of questions will be sent to you. You can prepare the answer in advance if you wish to and you can also choose not to answer any questions during the interview.
- The interview will be an hour long for each participant.
- The interview will be conducted in one of the meeting rooms at my office, during teaching weeks and at a mutually convenient time.
- The findings will be completely anonymous. Your real identities will not be disclosed in any reports and will be kept confidential through the use of pseudo names. No demographic details, except for gender and year of study will be reported. All recorded interviews and transcripts are only accessible to my supervisors and me.

This study has been reviewed and approved by the Research Ethics Committee at Monash University. I am attaching the Explanatory Statement and the consent form. Please read the Explanatory Statement in full before making a decision. If you are interested in taking part in this study, could you sign and email the consent form to me within one week's time.

Your participation would be greatly appreciated. If you have questions about the study or participation, please email me at [redacted]

Thank you.

[redacted]
Toh Bee Peng Diana

Appendix D – Scenario-based interviews

Scenario 1 – Describes a teacher's beliefs and her teaching approaches

Ms Jennie Walker is a high school lecturer teaching computing mathematics. She feels that training students in calculation skills is essential to prepare them in today's competitive job market. She also feels that theory, such as how the formulas are derived and/or when formulas should be applied in different scenarios, is not needed.

To do well in mathematics, Ms Walker confines her instruction to drill and practice. As such, students in the 11^{th} and 12^{th} grade are given lots of calculation questions to practice during tutorial sessions, instead of giving them real-life problems to think and solve. Students work individually and there is no collaboration activities – between students and teacher and among the students themselves.

Interview questions:

Q1: Ms Jennie Walker feels that understanding, such as knowing how the formula is derived, is not essential. She also confines her instruction to drill and practice. There is no collaboration activities and students work individually. Do you think that this was the right action by the lecturer in this situation? Why? What would you do?

Q2: From time to time people talk about collaborative learning and/or scenario-based learning. What do know about these approaches? What benefits do these teaching methods bring to learning? What are your views?

Q3: Professor Warren Esty, a Professor of Mathematics at Montana State University and Assistant Professor, Norah Esty, of Mathematics at University of California Berkeley believed that Mathematics is like a sport. One, even the best player, must practice a lot to get good. Could the experts' beliefs be incorrect? Do you trust the views of experts?

Q4: What is good learning? You may explain using an example.

Q5: What do you think is more important in a learning process?
Probes: Is it the process of understanding and applying the new information more important or is it the acquisition of specific facts more significant?

Scenario 2 – Depicts how the teacher used technology in the classroom

Although rapid advances in technology have created new possibilities for effective learning in education, traditional standing and delivering a lecture in front of a class remain the primary method of teaching for Ms Walker. She believes that traditional teaching method can effectively transfer knowledge to students. Ms Walker uses technology in e-learning weeks, for presentation and for administrative purposes, such as attendance marking and announcements.

Interview questions:

Q6: Ms Walker uses technology for presentation and for attendance marking and communications. What are your views on Ms Walker's use of technology?

Q7: In what way does technology help to improve teaching and learning? Can you give me an example of how it has improved your learning in school?

Q8: Can you give an example of how technology has helped you to learn?

Q9: What do you believe is good teaching practice in tertiary education?

Q10: How do you think you learn best?

Q11: What are your preferred ways of learning?

Scenario 3 – Illustrates students' views on their teacher's teaching method

During a survey, when the students were asked to share about their views on the current teaching method, they agreed with Ms Walker that they needed to get more practices with their Mathematics in order to excel. They felt that teachers must be right and teachers know what is best for the students. They even shared that they would approach Ms Walker for examination tips so as to score better grades in examination and to get a better job in future.

Interview questions:

Q11. What do you think of Ms Walker's teaching method, that is, students needed to get more practices with Mathematics in order to excel?

Q12: Can you tell me how you go about learning in various situations, that is,

a) *What do you do if you have difficulty with the topic or if you are preparing your weakest subject? What strategies would you use to help you understand the topic being taught in class?*

b) *If the assignment grade contributes significantly to your final semester grade, what strategies would you use to help you plan and do the assignment?*

Q13: How do you know you have learnt something?