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Thesis

A Case Study of How a Private School in Singapore Implements Technology in Teaching and Learning

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Declaration

This thesis is my work, and no part of it, has been submitted for a degree at this, or any other university.

Choy Seng Kim, Michael

Acknowledgement

I owe my gratitude to my God, Jesus Christ, who has given me strength and wisdom to undertake this life-changing endeavour for the past 4 years. He is not just God, He is also my Friend and Confidante in times of need. It has been a period of challenges, twists and turns. During these 4 years, I have gotten married, moved house twice, changed jobs and becoming a father twice over. It is amazing how I have stuck with chasing this doctorate despite the pain and agony. I guess I am a person who seldom gives up especially when I am committed to it.

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And to all the other teachers and students in Singapore, this study is for you! I hope the results will provide some fodder for thought, especially in the area of ICT use.

To God be the glory! Amen.

A Case Study of how a Private School in Singapore Implements Technology in Teaching and Learning

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Abstract

Singaporean Schools have been using Information Communication Technology (ICT) for more than two decades but little is known about the process of implementing ICT interventions especially in view of the range of ICT currently available and the pedagogical stress it places on teachers. By using a private school in Singapore as a case, this research study attempts to unpack the categories of ICT use from PowerPoint presentations to interactive learning activities so as to illustrate the interactional nature of pedagogy and technology in ICT-enabled lessons. The study recommends the use of two new terms 'Technogogy' and 'Teachnology' to better describe the ICT implementation process. The iTEaCH (ICT-Technogogy-and-Collegiality Holistic) Implementation Model comprising the dimensions of Technogogy, Teachnology and Collegiality and how they interact in the ICT implementation process is also proposed in the study.

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CHAPTER 1 - INTRODUCTION

'The introduction of new technology will change our schools… Unless it is harnessed to a clear vision of change then chip by chip, the technology could take us into a future that we would never willingly have chosen for ourselves.'

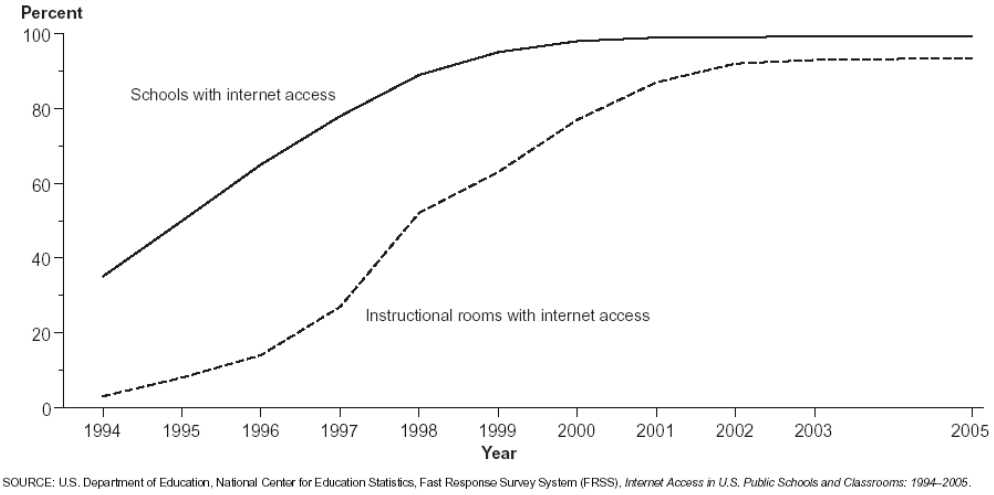
Conlon, T. (2000:p.116).

1.0 Introduction

One of the most fundamental problems in education reform, according to Fullan (2002) and Conlon (2000), is that educators do not have a clear and coherent sense of the reasons for change, what it is and how to proceed. Fullan (2002:p.18) notes that in order to '*accomplish lasting reform, we need leaders who can create a fundamental transformation in the learning cultures of school'*. In other words, working on changing the mindsets and perceptions of teachers to make them more open to change is as important as the change process itself. Often, the teachers who resist change are not rejecting the need for change but are resisting entering into something that they do not have the necessary knowledge and skills for. Fullan (1991) advocates giving opportunities to teachers to understand the changes brought about through the introduction of new technologies in the classroom.

Fullan (1991)'s study dates from almost two decades ago. Since he conducted his study on how teachers and principals manage cultural change in the school context, many technological breakthroughs have occurred - the internet is now widely available, wireless technology provides users with connections anytime anywhere, the mobile phone has become a ubiquitous item, and video sharing on YouTube and social networking through blogs and Facebook have changed the way people interact and work. With the proliferation of technology, it would be impossible for schools not to be impacted by such advancements. A recent compilation of statistics on schools in the United States by Synder, Dillow & Hoffman (2009) points to a rapid upscaling of technology facilities and access in American schools in the last decade.

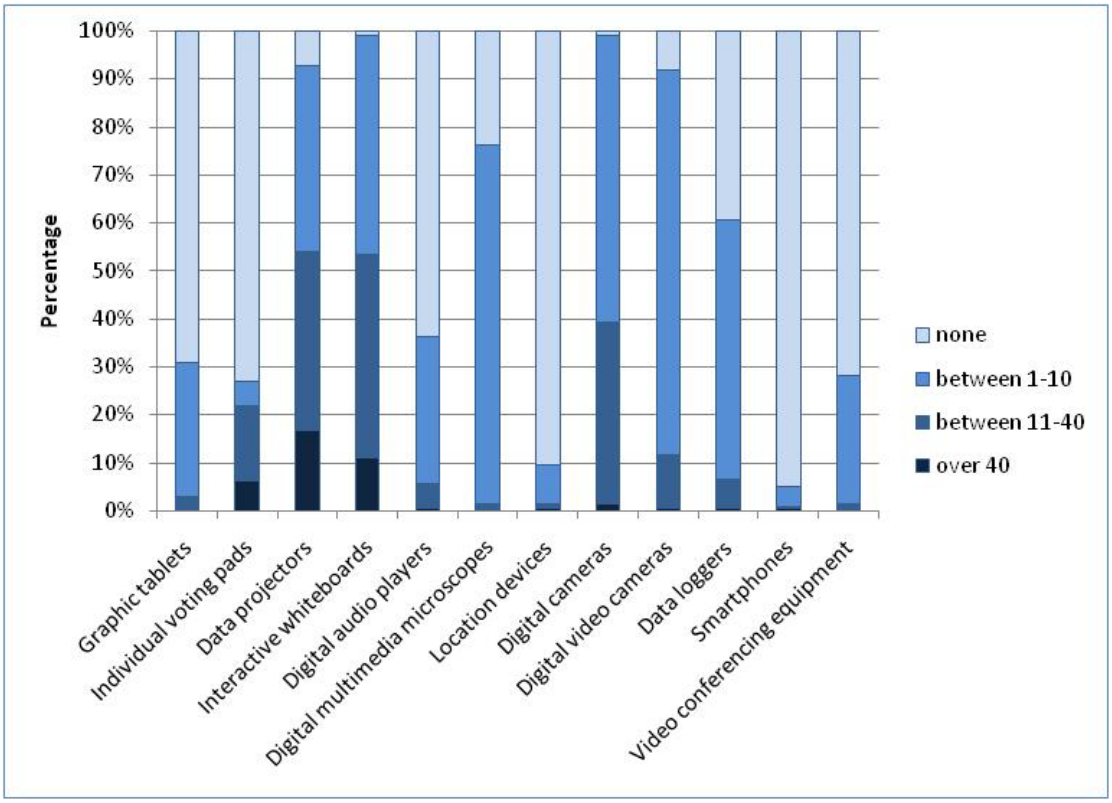
For example, schools with Internet access jumped from 35% to 100% between 1994 and 2005 (See figure 1.1).



SOURCE: U.S. Department of Education, National Center for Education Statistics, Fast Response Survey System (FRSS), *Internet Access in U.S. Public Schools and Classrooms: 1994–2005*.

Figure 1.1. Percentage of all public schools and instructional rooms with internet access: fall 1994 through fall 2005 in the United States (p.612)

The average number of computers in American schools more than doubled from 72 to 154 in the same period. The growth in the number of computers with internet access was even more astounding, rocketing from 447,000 to 12.245 million from 1995 to 2005. The number of students using computers in school rose in tandem with the increased number of computers available. From 70% in 1997 to 83% in 2003, the percentage of students using computers in school is expected to be a lot higher now. The increase in ICT is not limited to the United States. The type of ICT equipment available in schools in the United Kingdom (UK) has also increased dramatically over the years (BECTA, 2009). A survey of 2,862 teachers from across 831 primary, secondary and special schools in the UK revealed that interactive whiteboards and data projectors are some of the dominant technologies used on a daily basis in schools along with other devices for teaching and learning (see Figure 1.2. below).



Source: NFER Harnessing Technology school ICT co-ordinators survey 2009.

Figure 1.2: Number of devices available at schools for teaching and learning (p.11)

1.1 Identifying the Problem

These statistics seem to provide some evidence that technology is changing the way our children are taught in schools. It also alludes to the challenges that teachers face with the intrusion of technology into the classroom. Teachers are expected to manage technology equipment, change their teaching approaches, integrate technological tools into their lessons and outsmart a class of technology-savvy students who may know more about technology than their teacher. It will not be surprising to find that teachers are faced with increasing levels of stress juggling technology use, redefining their roles as facilitators rather than suppliers of information and managing an ever demanding class (Luke *et al.*, 2005; Zander, 2004). More than ever before in the history of education, teachers are required to be more flexible and skilled in managing teaching tools and students in the classroom and the question is “are teachers and schools able to cope with these challenges?”

These concerns are not unfounded. Studies show that problems still abound with regards to ICT (Information-Communication Technology) implementation (Chapman & Mahick, 2004). Many educators remain unclear about how ICT ought to be integrated into the curriculum (Donovan *et al*, 2007).

> *'Only as education leaders understand the issues associated with the effective use of technology in instruction can they effectively guide the process. However, educators and government officials lack clear models of successful technology use at the primary and secondary levels.'*
>
> *(Chapman, D., & Mahick, L., 2004:p20)*

According to Bain and Smith (2000), there is an immense gap between the promise of broader ICT research and the day-to-day reality of computer deployment. Somehow, the policies to infuse ICT into teaching and learning are not working out well in all schools for many reasons (e.g. Domitrek & Rabv, 2008).

It would appear that the problems which surfaced in research studies conducted in the 1990s (e.g. Fullan, 1991, Cox, Preston & Cox, 1999) on the use of ICT in education are still not resolved. The difficulties cited in those studies are now more prominent as technology advancement picks up pace and places a tremendous amount of pressure on teachers just to keep up, let alone fully utilise the technology in classroom teaching. Adding to that, there are, as Chapman & Mahick (2004:p.20) pointed out in their study, few 'clear models of successful technology use' in schools. It would be pertinent for educators to derive more exemplars so that others can follow the pioneers in this hunt for effective technology and teaching in the classroom.

Wells (2007) highlights the need to examine the broader issues related to ICT reform in the school in order to understand the reasons behind the lack of ICT implementation despite the available equipment. One clear factor appears to be the teachers' pedagogical beliefs, or the lack of belief about ICT effectiveness that teachers pay only lip service and not actually apply them in their teaching (McGrail, 2005).

1.2 The History of ICT Implementation

The next three sub-sections will briefly describe the history of ICT implementation based on American and European studies, beginning with the early 1990s, moving on to the early 2000s and finally in 2010. A subsequent section will focus on the implementation of ICT within the Singapore context.

1.2.1 The Beginning: The Early 1990s

Even back in 2001, Becker (2001) found that in the United States alone, there were over ten million computers in schools, and around six billion dollars was spent on technology for schools. However, the use of ICT was confined to acquiring computer skills rather than for learning purposes (Becker, 2001). From his survey of four thousand elementary and secondary school teachers, Becker (1994) found that only a small minority of secondary schools used technology for acquiring information, analysing ideas and demonstrating and communicating content understanding. The lack of good software and poor network infrastructure contributed to the phenomenon of using computers to acquire computer skills rather than for general learning.

This phenomenon was not confined to the United States. In a review of the Second Information Technology in Education Study (SITES-Module 1) of a representative sample of schools across 26 countries such as Singapore, Iceland and Italy in 1998 and 1999, Pelgrum *et al.* (1993) and Pelgrum & Plomp (1993) report issues relating to the lack of ICT use in schools. These issues describe the barriers to ICT implementation (insufficient computers by seventy percent of respondents), the lack of ICT knowledge and skills among teachers (sixty-six percent) and the difficulty in integrating ICT into instruction (fifty-eight percent). In a separate study, Fabry & Higgs (1997) estimated the budget for ICT training for teachers ranged from a lowly 4 to 15 percent of a school district's technology budget in the United States. The lack of professional development represented a significant barrier to technology integration.

As a result of the difficulties in integrating ICT, many teachers remained unconvinced that ICT use was appropriate for school-going children. These teachers were hesitant to immerse their students in ICT-enabled learning environments because

they were not confident that ICT would benefit their students as much as that offered by teaching without using ICT (Schmidt & Callahan, 1992; Drier, 2001).

1.2.2 The Changing Scene: The Early 2000s

Research in the early 2000s noted the importance of bottom-up initiatives by teachers. As highlighted by Gipson (2003),

> *'Often too the implementation of ICT is externally mandated by government policy and education authority edict. As a result, the technology is frequently never fully utilised to support and enhance teaching and learning …'*
>
> Gipson (2003:p.5)

The lack of communication among the different actors (e.g. teachers and management) highlights a larger problem in educational research - the need to situate and examine teachers' predispositions and beliefs within the larger context of organisational change and culture (Granger *et al.,* 2002). Gipson (2003) argues that the problems of ICT implementation in American schools lie in the learning process.

> *'It is evident, however, that despite the millions ploughed into the initiative, little impact has been made systemically on transforming teaching and learning in classrooms across the country. … insufficient strategic attention has been given to referencing these reforms to the core focus of teaching and learning.'*
>
> Gipson (2003:p3)

On the other hand, schools which focus on involving teachers in ICT implementation made good progress. Brewster Academy, a private secondary school in the United States, for example,

> *'… recognized that the challenges of school reform seemed to be … in the intricacies of the human dynamic associated with changing attitudes toward learning and learners …'.*
>
> *Bain & Smith, (2000: online article)*

These schools made addressing the psychological needs of both teachers and students the core of their reform strategy. Teachers with the right mentality towards ICT were recruited to provide the driving force behind ICT implementation in these schools. As a result, many of the initiatives noted were started and implemented by teachers themselves. Gradually, the teachers changed their mindset towards using ICT and coupled with that, the application of new teaching strategies.

> *'Teaching has changed. Today, more complex teaching activities are evolving to cope with changed classroom circumstances. Some teachers cannot, or will not, adopt them as their own.'*
>
> Eacute & Esteve (2000:p3)

The studies conducted in the early 2000s pinpointed the range of issues that educators have to address to roll out ICT successfully in the school and classroom. These issues are not easily solved and range from teachers' perceptions, skills and attitudes to a workable pedagogical approach to the availability of user-friendly ICT media. The proper resolution of these issues could lead to effective exploitation of educational technology for the benefit of teachers and students.

1.2.3 The Techno-Education Revolution: 2010

Moving forward to 2010, several mitigating factors now appear to drive ICT implementation in schools:

- The pervasiveness of technology in society and more importantly, among our school-going children is an impetus for educators to consider technology to engage, motivate and captivate them (Schussler *et al.*, 2007). According to Stone (2004), half the South Korean elementary children surveyed wanted a cell-phone for Children's Day while only 22% wanted a dog. This points to a need for schools, in particular teachers, to at least match the students' interest in technology or risk losing a whole generation of students to the more captivating attractions technology can offer.
- Improving technology reduces time needed to access web pages in class and leads to less equipment breakdowns and fewer teacher frustrations.

- Teachers are more equipped with technological skills as younger teachers grow up with technology. They may not be technology experts but at least they are not techno-phobic. In Prensky's (2001) terms, they are the 'digital natives'.
- The development of wireless technology allows a more ubiquitous use of ICT outside of the classroom. This includes using laptops with wireless connections and mobile phones to access information anywhere. Studies have shown this to be appealing to both students and teachers (Domitrek & Rabv, 2008).
- The spread of social networks makes ICT more appealing as learning can now occur with students and experts situated halfway across the globe in different countries and cultures. (Suguri *et al*. 2004)

As a result of ICT, pedagogical approaches now exist in a greater diversity leading to a greater acceptance of ICT among teachers (Zander, 2004). In Singapore, the Ministry of Education (MOE) spearheads ICT integration by making available huge amounts of resources to equip schools and teachers with the facility and skills in a very short period of time.

1.3 The Singapore Context

1.3.1 Government Schools and ICT

In Singapore, research findings on ICT use mirror the results of the studies mentioned above. In the early stages of ICT implementation, computer usage was mostly to train teachers and students in ICT skills (Info-Comm Development Authority, 2008). The Ministry of Education in Singapore introduced the ICT MasterPlan Phase 1 in 1997 (Info-Comm Development Authority, 2008) to equip all government schools with ICT in their classrooms. Approximately twenty-five thousand teachers in Singapore schools were trained to use software applications within two to three years with each teacher given an email address (Hu *et al.*, 2009). In Phase 2 (2003), the focus was on infusing ICT into classroom lessons. Good teaching was recognised as an important factor for ICT implementation. Currently in Phase 3 (2008), wireless networks are added to the ICT arsenal in some school environments so that learning can occur outside the classroom. In addition, e-learning portals to facilitate learning at home are being integrated into the school curriculum. These are examples of how government schools are adopting ICT on an

extensive level to equip students with ICT skills for the future workplace and job requirements.

In Singapore, the research seems to show that ICT exerts a positive impact on learning. For example, Li (2007), Looi *et al.* (2004) and Foo *et al.* (2005) found that ICT use increased learning and motivation among Singaporean students. The results of these studies are further highlighted in the literature review.

1.3.2 Reasons for Study on Private Schools

However, the situation for private commercial schools is very different from the mainstream government schools. These private schools cater to over-aged local students who want another attempt at the national examinations, or they serve foreign students who are in Singapore for a diploma or degree programme. Being business enterprises, there is little support from the government in terms of funding or training resources. These private schools are expected to fend for themselves and remain viable.

There are several reasons that private schools deserve further support and study. On the macro level, the rapid increase in the number of private schools catering to an exponentially increasing pool of foreign students and school drop-outs in Singapore (SPRING Singapore, 2008) makes the call for educators to examine the issue of quality education for these students in private schools an urgent one. A press release by the Ministry of Education, Singapore on 4 March 2008 stated,

> *'The private education landscape in Singapore has evolved rapidly over the years. The number of private schools has grown very significantly, from 305 in 1997 to 1,200 in 2007. The number of foreign students enrolled in private education organisations grew four-fold from 9,000 in 1997 to 37,000 last year' (2007).'*

With such rapid growth in numbers, standards differ considerably within the industry. As emphasised by Minister of State for Education, Mr Gan Kim Yong, in his speech at the FY2008 Committee of Supply Debate, the private education industry should "further develop to compete on quality, rather than faster time or ease of obtaining a

degree".' The seriousness of this issue has led to the setting up of the Private Education Bill which governs the quality of private schools and protects the fees that students pay to these schools. Mr Lee Yi Shyan (2009), Minister of State for Trade and Industry, stated in his speech at the Singapore Education Awards 2009 for private schools,

> *'Our education providers must continue to invest in content development, pedagogy research and industry exchanges to enhance the total learning experience of the students.'*

An expected part of content development and pedagogy research will be to increase the role of ICT in the curriculum and instruction. However, it is unclear to what extent ICT plays a role in learning within these schools. Unlike established private schools that cater to the upper class strata of the society in many countries, the majority of private commercial schools in Singapore were established within the past ten years to cater for low fee-paying foreign students from China, Indonesia and neighbouring countries (MOE, 2008). Hence, not many private schools are well-equipped with ICT nor do they have teachers who are well-trained in ICT use for teaching.

While the MOE has earmarked 5 to 10 government schools as ICT niche schools (e.g. Foo, Fan, Lee & Bawani, 2001) with the intention of using these schools as model schools, there are not many models for private, commercial schools in Singapore to follow. Perceptions of what constitutes good ICT practices are also lacking. Lessons in the classroom are still teacher-centred and teachers are still not using ICT to the extent that technology allows while school leaders appear vexed and even frustrated even after mapping out ICT policies and procedures for teachers to follow.

Generally, due to budget constraints, teachers in private schools face a lack of access to good ICT infrastructure and training. This also implies teachers need to be flexible and adapt available technology for lesson delivery. The lack of government funding for these schools also indicate a lack of 'top-down' control from the MOE and this provides interesting data for examination since the school management has a freer hand in determining strategies and directions. Given their relatively smaller

sizes of between 200 to 500 students compared to 1200 to 2500 students in public schools, private schools are more agile when implementing new initiatives, thereby shortening the lag time between implementation and observable results.

On a personal level, having been involved in training teachers from both public and private commercial schools for the past 13 years, I understand the challenges teachers, especially those from private commercial schools, face. Despite having the passion to teach and the desire to make a difference, the environmental constraints such as time limitations, lack of facilities and little technical support prevent these teachers from teaching the way they would like to. I desire that through this study, clear guidelines pertaining to ICT adoption and implementation in schools can be developed to facilitate the use of ICT by teachers despite the environmental constraints.

1.4 Research Problem and Aims

The research problem is that it is unclear how school leaders, teachers and technical staff develop and use ICT for teaching and learning in private schools given the range of constraints present in these schools. Central to this issue of ICT use is the need to understand how teachers, technical staff and school leaders perceive the use of ICT in the classroom. If they do not view ICT use positively, then there is no incentive nor impetus to carry out ICT-based lessons to a significant extent. In addition, the manner in which these key actors in the school interact to produce a coherent ICT strategy would provide useful information in the development of a working model for other private commercial schools.

To address the issues listed above, this study aims to investigate, using a case study, how teachers, school leaders and technical staff in a private school perceive the role of ICT and interact together to manage their ICT strategy. This private school has shown good progress in dealing with school drop-outs and turning them around through its innovative teaching methods and use of ‘cheap’ technology in the classroom.

1.5 Research Question

The research study will focus on how the three sets of actors (teachers, school leaders and technical support staff) interact with each other to produce a credible working framework for ICT implementation. Keeping the research aim in mind, the main research question is:

> *'How have teachers, school leaders and technical support staff in a Singapore private school (Cool School) managed the implementation of ICT in the curriculum across the school?'*

1.6 Specific Research Questions and Methods

From the main research question, five specific research questions are developed:

	Specific Research Questions
1.	What are the teachers' and school leaders' perceptions towards the use of ICT in the classroom?
2.	What are the teachers', school leaders' and technical staff's perceptions towards the available ICT infrastructure in Cool School?
3.	How do teachers and school leaders view the link between technology and teaching?
4.	How do the management and teachers collaborate to implement ICT initiatives in the school?
5.	What are the teachers' and school leaders' perceptions towards the ICT policy in Cool School?

The fourth question on teacher collaboration was added after the pilot trial when it appeared that, from the preliminary analyses of the data, the ways the actors interacted and collaborated impacted the implementation process and thus, deserved more attention. Examination of the research questions suggests that the key research methods will be interviews supplemented by documentation and school visits. The choice of research methods will be justified in Chapter 3.

The number of participants involved in case studies varies widely but most studies range between 10 and 15 participants (e.g. Yin, 2003; Watkins *et al.*, 1999, Li, 2007). The current study uses a similar sample size - 12 to 15 teachers, school leaders and

support staff (with each interview lasting about an hour). Additional information is obtained from the participants through simple written responses to open-ended questions, especially for staff not keen to be interviewed.

1.7 Conclusion

The rapid rise in the number of private schools bears testimony to the fact that Singapore is emerging as the educational hub for Asia.

While government schools have ICT niche schools as exemplars, there are none (at least not funded by the government) among the private schools. Hence, it is in this context that the study attempts to provide a useful model for private schools to use ICT as a teaching and learning tool so that private school teachers and students can benefit from its use.

The results of this study will provide useful perspectives on how other private schools can implement ICT in their school with a limited budget, poor teacher training opportunities and possibly low incoming student quality. In so doing, the use of ICT would lift the standards of teaching in private schools, doing greater justice to the 90,000 students who are enrolled in private schools at great cost to themselves and their families.

Without the constraints of MOE's jurisdiction, the study will provide interesting findings if a private school can innovatively implement ICT effectively at relatively low cost. Given that there are few models of ICT implementation adapted to the Singapore context, this study would add to the working models available, similar to what Brewster Academy (Bain, 2000) is doing for the schools in USA. Obviously, the transfer of the findings to mainstream schools would be limited due to different contexts. However, the findings could prove useful for public school management boards to consider.

The discussion of the literature review in Chapter 2 will help drive the direction for the study. Chapter 3 will discuss the rationale for taking a qualitative approach to examine the teachers' thinking and reasons behind their perceptions and behaviour.

The gathering of data includes interviews at the pilot, main study and follow-up stages, qualitative surveys to profile the interactions among teachers and documentation of online web pages currently used by students and teachers. Other issues discussed include the methodological approach adopted and measures taken to ensure trustworthiness, validity and reliability. In Chapter 4, the results of the study are described based on the Specific Research Questions. Chapter 5 discusses the findings and the implications for future research in this area of ICT implementation in Singapore private schools. The final objective is to be able to generate a useful working model for private commercial schools to consider when it comes to ICT implementation.

CHAPTER 2: LITERATURE REVIEW

2.0 Overview

The introduction in Chapter 1 provided a general description and direction of the study. This chapter will delve into the literature underpinning ICT implementation so as to inform the conduct of the study. The chapter begins by describing the context for the growth of ICT use in education. This is followed by an examination of various models focusing on different aspects of the ICT implementation process in schools. With teachers playing a central role in the use of ICT for teaching, three key areas are reviewed: teachers' skills at teaching and ICT use, teachers' ability to integrate ICT into the curriculum and the school culture and policies needed to support teachers' continual experimentation with ICT. The chapter ends by contextualising the literature to the needs of private schools in Singapore.

2.1 Context for ICT Growth

In most countries, the primary reason driving ICT implementation in schools is basic economics. People remain the greatest resource of any nation and to equip the young with effective skills and vital knowledge is crucial to the survival and prosperity of the nation. Education ministries and commercial industries want ICT skills to be taught in schools (Vonderwell *et al*, 2007). According to the former Prime Minister of the United Kingdom, Tony Blair, in a preface to a 1997 document for the Department for Education and Skills:

> *'Technology has revolutionised the way we work and is now set to transform education. Children cannot be effective in tomorrow's world if they are trained in yesterday's skills. Nor should teachers be denied the tools that other professionals take for granted.'*
>
> Blair (1997:Preface)

However, the key assumption that technology will revolutionise the way our children learn needs to be questioned given the huge cost involved. The literature in general shows ICT use in schools improves student motivation, teacher-student interaction and social growth (Gros, 2007). ICT can also play a part in empowering students to

become active learners in the otherwise usually passive learning process of traditional classrooms (Luke *et al*., 2005). With ICT, students can share the responsibility of learning with the teacher as they search for relevant information and decide on how they want to learn a particular topic. Prensky (2003)'s research findings indicate that ICT when used constructively and purposefully in the classroom empowers students to make decisions to enhance their own learning process. No longer tied down by the traditional blackboard and classroom environment, teachers and students can now explore the world through online portals and information repositories (such as www.about.com) or multimedia resources (such as Google Earth and www.youtube.com). These resources and alternative strategies engage individual students with activities that match their learning abilities and styles (Dunn & Dunn, 1993).

In his commentary of the advancements in ICT implementation in German schools, Zander (2004:p.279) included the reasons that principals stated as most important for the use of ICT:

- To make lessons more interesting
- To support autonomous and independent learning
- To support project-oriented learning and individualized learning

Additional reasons given by ICT coordinators in the same study were:

- To help students achieve basic skills in information searching and analyses
- To enhance pupils' motivation and interest
- To promote teamwork skills

The reasons for the development of ICT seem to be multi-faceted with students' interest being a key factor for both school management and ICT coordinators. While ICT seems to increase students' interest, Zander's (2004) study found the opposite result with teachers:

> *'One incontestable result is the high level of motivation of students and, by contrast, the quite low level of motivation among the staff. Only half of them are considered to be motivated.'*
>
> Zander (2004:p281)

It seems puzzling that teacher motivation levels are so low especially when contrasted with the high student motivation level. The disparity is startling considering that many teachers are aware of the benefits that ICT brings into the classroom (Becta, 2009). The issue seemingly is not just about teachers implementing ICT in their classroom, it is also about how they can do so within the context of their schools and whether the school culture can sustain ICT implementation (Schussler *et al*., 2007; Slay et al., 2008). Without peer support or sufficient role models, many of these ICT innovators may just fizzle out (Rogers, 1995) in the long run.

Hence, this study will take a broader perspective of how ICT is implemented in the classroom in relation to what the teacher does in the classroom and how these actions are perceived by fellow colleagues and the school management. The latter is especially important since teachers eventually have to reflect what management prescribes (Domitrek & Rabv, 2008).

2.2 Implementation of ICT in Schools

Among the many models on how teachers implement ICT in their classroom, the models presented by Rogers (1995), Sandholtz *et al*. (1997), Cox & Graham (2009) and Schussler et al (2007) provide a range of different perspectives on ICT implementation in school.

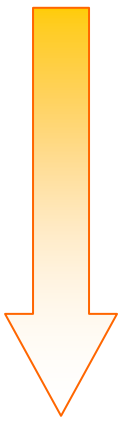
One of the earliest models (Rogers, 1995) types teachers in terms of how responsive they are to ICT implementation. According to Rogers (1995), there are five types of teachers based on their response to change (for example, ICT initiatives):

1. innovators (eager to try new ideas)
2. early adopters (follow innovators and are successful users of technology)
3. early majority (wait to see how successfully technology is implemented before following)
4. late majority (wait till they are pressured to use or are persuaded of its benefits before trying) and
5. the laggards (the last to adopt change).

Underpinning the differences in teachers' responses are their personal experiences with ICT. It would appear that the level of motivation is linked to the teacher's experience in ICT use. Zander (2004) found that there is a significant difference in teacher attitude concerning the impact of ICT on learning between regular Internet users and less frequent users. Teachers who use the Internet at least once a week state more often that classes were fun and they have more confidence in the pedagogical impact of the use of computers and the Internet on their students.

While commendable, Rogers' (1995) approach to typing teachers based on their responses to change may be somewhat simplistic and one-dimensional, given that teachers who are innovators may not be the most effective users of ICT and it does not show to what extent ICT is used before teachers are considered to have accepted and embraced the change. Rogers' (1995) model does, however, illustrate that there are different types of teachers in schools and different treatments may be needed to facilitate the implementation process for the teachers in schools.

Complementing Rogers' (1995) work on teacher types, Sandholtz *et al*. (1997) traced the pathway that teachers usually take when implementing ICT in their class. Beginning with supporting existing teaching approaches (such as PowerPoint presentations), teachers develop strategies to involve students' participation (such as cooperative learning). According to Sandholtz *et al* (1997), teachers in the 10-year 'Apple Classrooms of Tomorrow' (ACOT) project passed through five developmental stages (see Figure 2.1) as they evolve:



Entry	into ICT framework
Adoption	of ICT for classroom use
Adaptation	adaptation (of ICT) based on students' needs
Appropriation	of different kinds of ICT
Invention	of new uses for current ICT

Figure 2.1. Development of a teacher's professional skills at integrating ICT in the classroom based on Sandhotlz et al. (1997)'s Stage Theory

As teachers advance through these stages, their use of technology becomes more frequent, complex and flexible. The Stage Theory (Sandhotlz et al., 1997) presents how a classroom teacher needs to constantly evolve and adapt not just to the changing technology but also to the growing complexity of ICT use as he or she moves through the stages to implement lessons that are constructivist, generative, and less didactic in nature.

While Sandhotlz et al. (1997)'s Stage Theory provides additional details on teacher skill development compared to Rogers' (1995) Response model, both models do not provide a comprehensive view of the ICT landscape that the teacher is in *and* the development of the teachers' professionalism and attitudes as they journey through the ICT landscape. Given that both models are relatively dated and with the advent of technology, it is incumbent on educators to search for new ICT implementation models which take into account the complexity of technologies and the range of pedagogical skills demanded of teachers to operate them. Schussler et al. (2007:p.573) highlight that the Stage Theory which perceives *'ICT integration as a one-dimensional incremental process'* is untenable, given the complexity of the teaching process. What is needed is a

> *'…multi-dimensional model (that) captures the complexity of inter-connecting layers within teachers' thinking, practice and development that enhance or detract from the integration of technology.'*
>
> Schussler et al. (2007:p.573)

To capture the complexity of the teaching practice and process, Mishra and Koehler (2006) introduce the TPCK model (see Fig.2.2) which emphasises three types of knowledge constructs:

- Pedagogy (PK)
- Technology (TK)
- Content (CK)

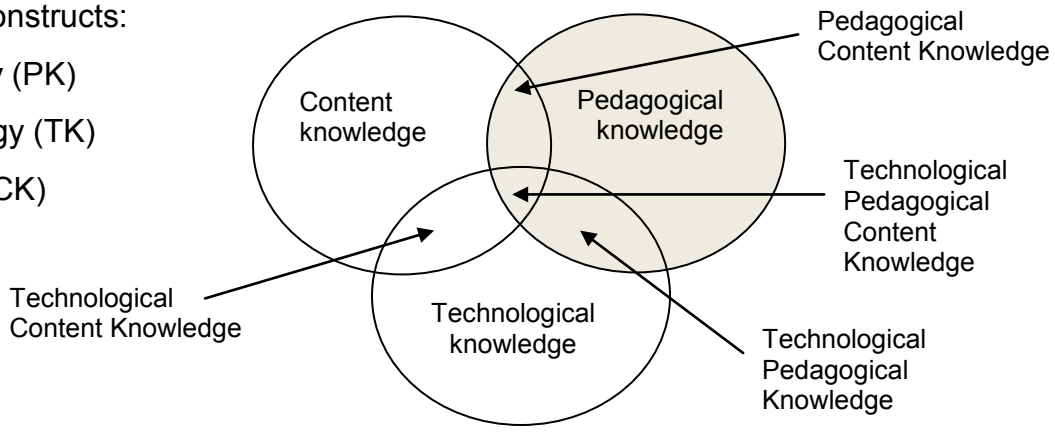


Fig 2.2. The TPCK Model as proposed by Mishra & Koehler (2006)

Together, these three constructs constitute TPCK (Technological Pedagogical Content Knowledge) although the focus is really on the interactions between them.

> *'At the heart of TPCK is the dynamic, transactional relationship between content, pedagogy, and technology. Good teaching with technology requires understanding the mutually reinforcing relationships between all three elements taken together to develop appropriate, context-specific, strategies and representations.*'
>
> Koehler et al.(2007:p.741)

One key issue that the TPCK model attempts to address is the manner in which ICT training is conducted for teachers, which often is in isolation of the subject-specific context (Becker & Riel, 2001; Selinger, 2001).

> *'As a consequence, the programmes fail to adequately prepare teachers in ... establishing pedagogical connections between affordances of technology and the teaching of a particular content domain.*'
>
> Angeli & Valanides (2009:p.155)

By focusing on the overlap between technological, pedagogical and content knowledge (or TPCK), the model refers specifically to the need to situate the ICT training and use within the context of teaching and the content, in order for the training to be effective. Logically, the implementation of TPCK model in the classroom would also require the examination of how technology, pedagogy and content interact to design learning-appropriate lessons. There are specific articulations of how TPCK is used to describe teachers' attempts at using ICT to make content accessible to the students. For example, Cox & Graham (2009) mapped TPCK (or TPACK as they termed it) to how a history teacher (Mr Jorgensen) used weblogs with his students to understand first-hand accounts of history. By getting his students to examine the blogs of other students and historians and then write their own weblogs, the students could reflect on the current world events in a reflective manner. Based on Cox and Graham (2009)'s explanation using the TPACK model, the TCK (Technological Content Knowledge) was illustrated in

Mr. Jorgensen's knowledge of how Web 2.0 (or Weblogs with first-hand accounts of world events) could transform the representation of history. Additionally, TPK (Technological Pedagogical Knowledge) was illustrated through his knowledge of how blogging can be used with *general* pedagogical strategies e.g. motivating students to reflect and then create better work through blogs. Finally, Mr. Jorgensen illustrated TPACK (Technological, Pedagogical and Content Knowledge) when he utilsed blogging in support of content-specific activities (researching first-hand accounts of world events as primary sources of history). Here, the researching of the accounts (PK) is specific to history (CK) using weblogs (TK) and is differentiated from TCK and PCK.

As a model, the TPCK (or TPACK) provides compelling reasons for teacher training to focus on how subject-specific ICT use ought to be carefully designed and implemented in the classroom. It differentiates general PK from TPK and TPACK. This differentiation sets the stage for the need to review how subject-specific ICT use, in conjunction with good pedagogical practice, can be further supported in schools. At the same time, the TPACK model also suggests that ICT implementation is not as straightforward or as simplistic as the models described earlier (i.e. Roger, 1995; Sandholtz et al., 1997).

There are, however, several issues with the TPCK or TPACK Model. For example, according to Angeli & Valanides (2009), it is not clear if growth in TPCK is a distinct form of knowledge or whether growth in any of the related constructs will improve a teacher's TPCK. This implies that the boundaries between the TPCK components can be 'fuzzy indicating a weakness in accurate knowledge categorisation ... a lack of precision in the framework' (Angeli & Valanides, 2009:p.157).

It is also unclear how teachers can utilise the TPCK model in the classroom, other than knowing that there are these three constructs and their interactions. Does this imply that to take ICT implementation forward, schools will require detailed descriptions of how ICT ought to be used for each topic along with the pedagogical activities that accompany it? Will this be overly onerous for schools to implement, leading to a highly inflexible structure?

In addition, TPCK, as a model, seems to describe in a static manner what is actually a dynamic process concerning the use of ICT in the classroom. In the example given by Cox and Graham (2009), the history teacher could have presented the weblogs to the students using LCD projectors and have them discuss the content in groups. Instead of writing individual weblogs, the students could have recorded their comments on video and posted the clips on YouTube. Will this alternative mode be recorded as the teacher‘s TPCK? If so, what value does the TPCK model add to the whole process of ICT-assisted teaching? Can the model recommend specific pedagogical approaches to the use of certain types of technology for particular subjects? For example, is presenting the blogs to the students a better alternative to getting the students to conduct the research themselves? How do teachers judge? In other words, is there a ‘fitness-for-purpose’ between the technology used and the pedagogial approach? These questions will be reviewed at the end of the study, to see if they can be addressed.

In contrast, Schussler *et al*. (2007) propose a more dynamic 5-layered model (see Figure 2.3) which shares similar characteristics with Sandholtz’s model. What is interesting is the inclusion of the teacher’s familiarity with the *content* AND with *technology* in Schussler’s Hypertext Model. To some extent, these two layers would fall into the ‘entry’ and ‘adoption’ stages as the teacher grapples with technology and curriculum. Another layer (Connectivity) focuses on the teacher’s ability to integrate technology into the curriculum in an effective manner. As Schussler *et al*. (2007) admit, this layer is akin to the ‘invention’ stage in Sandholtz *et al*. (1997)’s model.

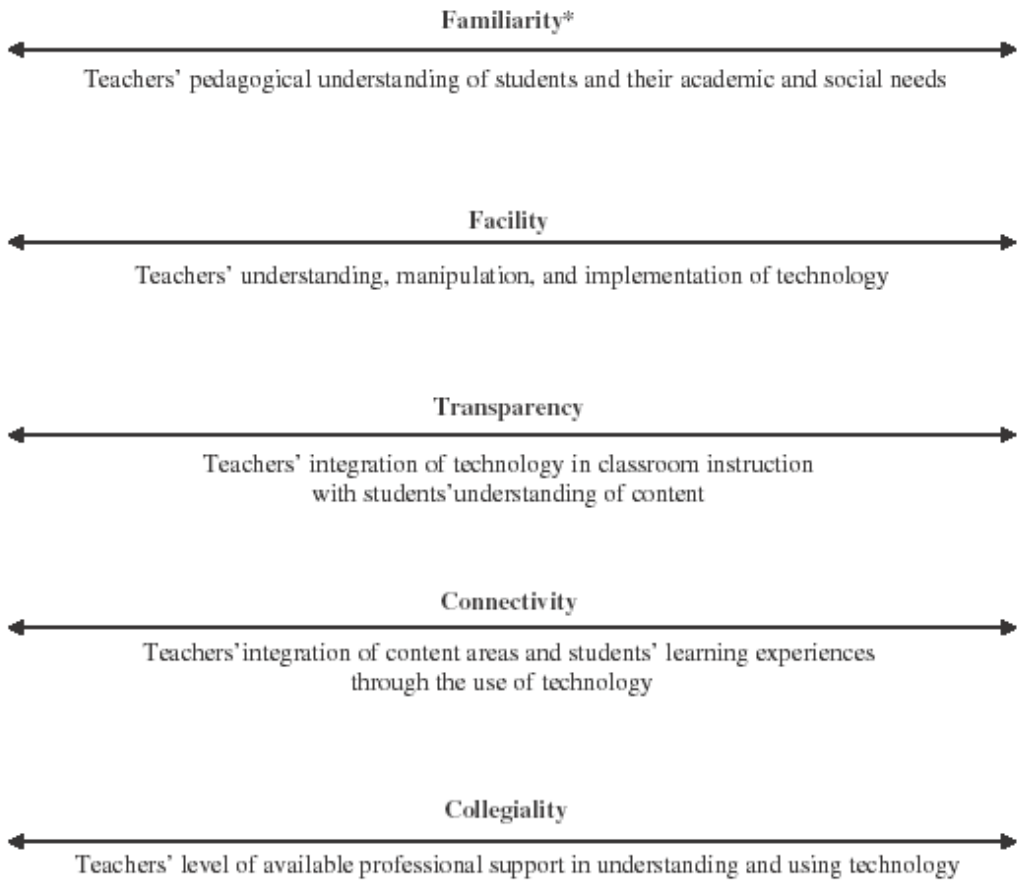


Figure 2.3. Schussler et al. (2007)'s Hypertext Function Model

As Roger (1995)'s, Sandholtz *et al*. (1997)'s and Schussler *et al.* (2007)'s models suggest, progression through the stages or layers involve the mastery of higher level skills in both managing pedagogical change and technology use in the classroom although in Schussler *et al*. (2007)'s model, the progression is concurrent across the five layers, 'jumping' from one layer to another with development of skills occurring for each layer. One advantage of Sandholtz *et al*.(1997)'s Stage Theory is that it is easily understood and presents a useful gauge to determine the level of ICT expertise in the school, indicating if most teachers are in the entry stage, invention stage or somewhere in between. However, in part due to the simplicity of the Stage Theory, the Theory fails to take into account key factors such as school culture, peer support and teacher characteristics (Belland, 2009; Slay *et al*., 2008) which are deemed as important and need to be considered as well. In this regard, Schussler *et al*. (2007:p.580)'s conceptual framework of hypertextual function (operating like the links seen in webpages) 'captures some of the complexity teachers face as they attempt to use technology in their classrooms.' The five layers in the model are further grouped by Schussler *et al.* (2007) into three key areas (see Table 2.1):

a) Teacher's Thinking	b) Teacher's Practice	c) Teacher's Development
Familiarity	**Transparency**	**Collegiality**
Facility	**Connectivity**	

Table 2.1. Factors in Schussler *et al's* (2007) Hypertext Model Grouped into 3 Broad Areas

According to Schussler *et al.* (2007), these three areas highlight the teacher's internal thought processes, the actual ICT practice by the teacher within the school context and the teacher development processes such as support mechanisms and training available to the teacher in the school. Familiarity and Facility denote the teacher's comprehension of the pedagogical and ICT possibilities respectively. In turn, the way the teacher translates his or her thinking about ICT into practice is captured under Transparency and Connectivity which denote integration of ICT into curriculum within a topic and connecting different disciplines using ICT respectively.

To illustrate the application of the Hypertext Model, Schussler *et al.* (2007) profiled three teachers, of which the case about *Amy O'Reilly* is summarised below.

Amy teaches geometry at Northpark High School and described her knowledge of technology as a product of her colleagues' knowledge. In particular, the Geometer's Sketchpad was a software that she learned from an ex-colleague and one that she was keen to use with her students at Northpark High. She had some initial problems getting the technical support to install the software on the school computers. There were few opportunities for her to collaborate with her colleagues so she was very much on her own in implementing the software. Her motivation was to get the students to discover geometry in a hands-on way which, in her opinion, is 'more valuable to them'. According to Amy, the material can be covered faster. At the same time, she was aware of her students' needs, as shown in the manner she identified the weaker and more able students. Schussler et al. (2007) argued that Amy's integration of the software into the curriculum was seamless but lacked linkages with experiences outside the classroom or with other topics. Thus, while the transparency

layer is well-defined, the connectivity layer will be limited. The snapshot of Amy's hypertexual function was depicted as such:

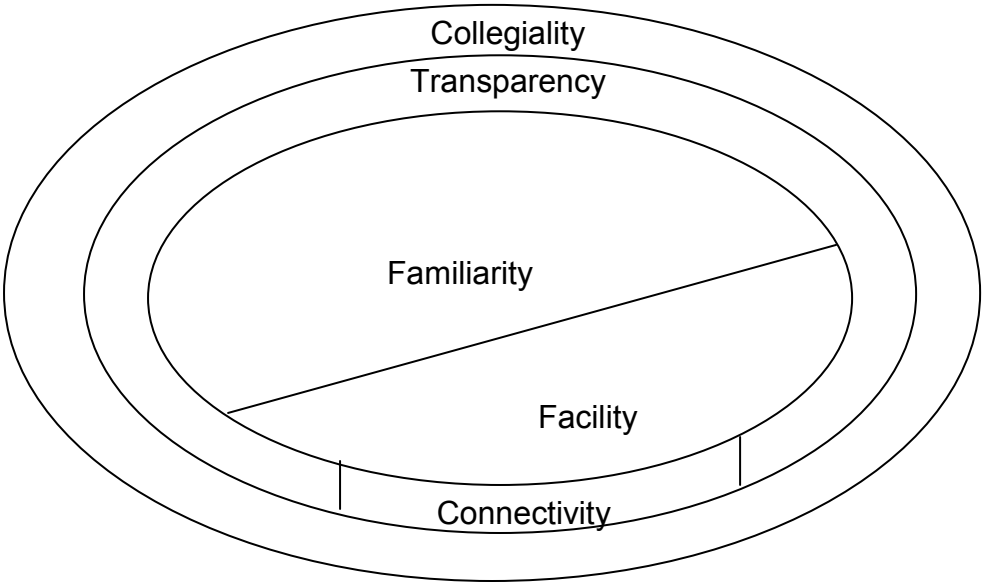


Figure 2.4. Hypertext Function of Amy's Use of ICT

Based on Amy's profile (See Fig. 2.4), there are a few issues which require clarification. Firstly, assuming that the width of each band would relate to the 'strength' of the layers, the Familiarity and Facility naturally occupy a larger area. However, it seems strange that Transparency, being Amy's strength in integrating the Geometer's Sketchpad into the Geometry curriculum, is relatively 'thin' even though it is 'longer' than Connectivity. Would the length compensate for the thinness of the layer? This is not explained and in Amy's case, collegiality was almost nonexistent, except for some technical help, yet it is 'longer' than Transparency. Are there grounds to compare the layers? If not, then why depict the profile in such a manner which can mislead the reader? It is also arguable if the layers can be compared in the first place, since the categories are different, much like comparing apples and oranges.

Secondly, with the Hypertext Model focused on how teachers utilse ICT in the classroom, is there a need to separate the layers Familiarity from Transparency? Even if the teacher is familiar with the students' needs, does it mean that she will apply good pedagogical principles based on *those* needs in the integration of ICT? For example, would it be possible for Amy to be familiar with the strengths and weaknesses of the students in her class (strong Familiarity) and yet, at the same

time, integrate ICT into the curriculum *without* considering those strengths or weaknesses? Familiarity, in the Hypertext Model, does *not* refer to how the teacher addresses the students' needs through the application of ICT. Familiarity is primarily about knowing those students' needs while Transparency is about integrating ICT into the curriculum to achieve the instructional objectives. According to Schussler et al. (2007:p.577), 'To make technology transparent, teachers must first be aware of how technology relates to their learning goals'. While learning goals are important, the focus of Transparency is about achieving those goals, based on characteristics of the curriculum with little direct reference to the needs of the students. One may argue that the two layers: Familiarity and Transparency ought to be integrated to ensure that there is deliberate consideration of both layers simultaneously so that the integration of ICT achieves instructional goals *based on* the needs of the students.

Thirdly, Transparency and Connectivity are supposedly different ways of integrating ICT into the curriculum; the key difference being whether it is within or across topics. It is unclear from Schussler et al.'s (2007) paper if there are any significant differences in practice between Transparency and Connectivity since both involve integration of ICT into the curriculum and what these differences are, if any. Do they fall into the same spectrum of ICT integration? Wouldn't it be easier to allow the instructional goals to determine the need for cross-topical integration? In the case of Amy, if the instructional goals do not require her to link Geometry with other topics or experiences, would it be unnecessary or even presumptuous of the Hypertext Model to insist on evaluating this layer of cross-topical integration? It is arguable if Amy was less proficient when she neglected the integration of other topics in the Geometry lesson. It may not be the case as her focus is on helping her students achieve the instructional goals. Perhaps, broadening Transparency to include cross-topical integration, with the focus on achieving instructional goals will allow easier usage of the model.

Finally, the 'Teacher Development' category is somewhat difficult to justify as there is only Collegiality parked under it. Wouldn't it be confusing to have two terms (Teacher Development and Collegiality) to denote the same concept? The model also does not distinguish different types of collegiality (e.g. support from technical specialists,

informal sharing among peers and students rendering of ad-hoc help). To what extent this differentiation is useful is worth examining at the end of this study.

However, compared to Rogers' (1995) and Sandholtz *et al.* (1997)'s models which encapsulate pathways of progression for the teacher, the multi-dimensional Hypertext Model appears to provide a more comprehensive picture of the complex interactions which take place within and without the teacher. In this regard, it could be a useful framework for this study to adopt in the examination of the numerous factors that affect ICT implementation in the school context. The following sections will systematically focus on the major issues that pertain to each of the three key areas highlighted by Schussler et al. (2007):

1) Teachers' Thinking
2) Teachers' Practice
3) Professional Development

2.3 Teachers' Thinking (Familiarity & Facility)

2.3.1 Familiarity

To begin, the teacher's familiarity with pedagogical skills is a key factor. According to Diaz (2001), schools often implement ICT initiatives by pushing teachers to adopt technology without ensuring that they have a good understanding of the technology or the integration process. There are some fundamental shifts in pedagogical approaches when ICT is used in place of traditional teaching media.

The importance of pedagogical change in ICT implementation is highlighted in a survey commissioned by Becta (2009) with 2,832 teachers from 831 schools in the United Kingdom,

> *'… at a system level, there are still some indications from the survey findings that technology is being used for display and presentational purposes rather than for interactive and engaging learning activities.'*
>
> Becta (2009:p.19)

Fabry & Higgs (1997) argue that for teachers to effectively integrate technology into classroom practice, they must make two radical changes – besides learning to use technology, "they must also fundamentally change how they teach."(p388). To fully maximise the benefits of ICT in learning, teachers need to move away from a teacher-centred classroom to a more student-centred classroom. A key differentiating factor in determining successful ICT use is the adoption of learner-centred ICT activities (Chapman, 2004).

For example, Harasim *et al.* (1995), in their book "Learning Networks", have identified various types of activities which can be carried out on the Internet, and have categorised these as teacher-centred and learner centred, as shown in Figure 2.5 below.

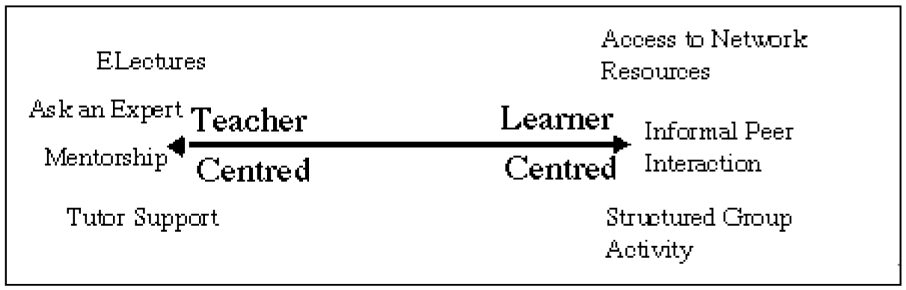


Figure 2.5: Categories of online learning activities (Harasim *et al.*, 1995)

The current thinking is that the most effective method of computer-based learning is through a range of broadly constructivist learner-centred approaches such as peer discussion platforms and resource sharing portals (Chapman, 2004; Phillips 1998) in contrast to the teacher-directed or more didactical approaches such as e-Lectures or e-tutor support. This implies that ICT takes on the role of a collaborative tool in addition to being a medium for transmission of content. By encouraging learning through interaction, social discourse and situated cognition, ICT as a collaborative tool enhances constructivist learning which goes beyond the mere accumulation of facts. Luke *et al*. (2005) noted that

> *'This suite of (ICT) initiatives (IT MasterPlan 2 in Singapore) is unified by at least one major policy theme: a recognition that the didactive, traditional and rote reproductive character of pedagogy needed to change.'*
>
> Luke et al. (2005:p.11)

While both Fabry & Higgs (1997) and Luke et al. (2005) recognize the need for pedagogical change, the issue is about the manner in which pedagogical change should take place. Constructivist learner-centred approaches can occur in many forms and it is unclear if all forms of learner-centred approaches are effective. In any case, the difference between didactical and constructivist may be difficult to establish since they generally fall into a spectrum as shown above in Harasim *et al.* (1995)'s diagram.

Examples of learner-centred activities include students using interactive software to explore new content, students solving Mathematical problems to reinforce taught content and students making presentations using video facilities on issues they have researched (Staples *et al.*, 2005).

In general, there are a number of studies and models on ICT use (e.g. Slay *et al.*, 2008; Domitrek & Rabv, 2008; Schussler *et al.*, 2007) which tend to focus specifically on the use of ICT (whether in a constructivist or didactic manner) and ignore the non-ICT activities which may supplement or reinforce the concepts acquired through the ICT segments. For example, a teacher may employ video conferencing facilities for her students to watch a presentation by an expert on a particular topic. If the students are non-auditory, many of the concepts mentioned during the video conferencing may require reinforcement through the subsequent group discussion or project work. This non-ICT segment will be critical to ensure the students are clear on their understanding of the concepts and apply them in accordance to the instructional goals set. To disregard the non-ICT segment of a lesson will appear strange since ICT application does not occur in isolation of the non-ICT activities. It is critical that the effectiveness of ICT use be examined together with what happens before and after the ICT segment, and if the various segments together help the students achieve the instructional goals for that lesson.

It would appear that regardless of the cognitive processes involved, as long as technology was used in any part of the teaching or lesson, it would qualify as an ICT-enabled lesson. There appears to be little examination of how effective the different modes of technology use are, whether to 'supplant' instruction (i.e. to provide inputs)

or to follow up on instruction (i.e. to ensure mental processing and production) on the eventual learning outcomes exhibited by the students.

> *'Some teachers used technology to supplant usual instruction, others used it to augment or follow up on instruction.'*
>
> Staples *et al.* (2005:p.297)

It is also unclear if teachers have a preference to use technology for a certain segment of the cognitive process. This is an important distinction which appears to be absent in the literature. To help us further differentiate the different forms of learner-centred activities, Choy (2009) and Witkins (1984) advocate splitting the constructivist learning process into three segments: perception, mental processing and production (See Figure 2.4 for LAMP Model).

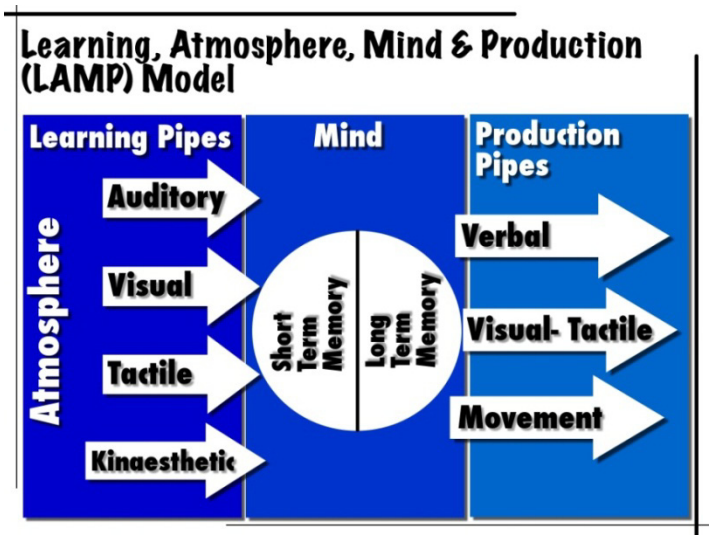


Figure 2.6. Learning, Atmosphere, Mind & Production (LAMP) Model by Choy (2009)

From Figure 2.6., learning constitutes the process of gathering inputs while mental processing involves the integration of new information with existing mental structures. The production process comprises verbal, written or bodily expressions. Often, when educators (e.g. Staples *et al.*, 2005) refer to the learning process, they really mean a combination of different activities (perception, processing and production).

In Staples *et al.* (2005)'s study, much of the reported ICT usage by teachers and students will fall into the production process – students developing PowerPoint slides

and using computers to type out their reports, rather than to receive information (inputs). From the pedagogical perspective, whether the production-type of activity-based learning is effective for learning remains unclear. Equally important is the issue of whether teachers are equipped to adopt different pedagogical approaches (or Familiarity) when using ICT in the classroom (Schussler et al., 2007).

2.3.2 Facility

The second dimension 'Facility' in Schussler et al. (2007)'s model refers to teachers' understanding of how technology can be used for teaching.

A study by Chapman (2004) outlines 7 ways in which ICT is used by teachers:

1. Direct instruction – lesson prepared in one location could be broadcast via emails, blogs, websites or television to reach students in other locations. A clear illustration is the availability of video lessons on YouTube academia and MIT (Massuchusett's Institute of Technology)
2. Searching for resource materials online to be used in the lesson preparation. For example, maps and factsheets about the history of World War Two.
3. Accessing online curriculum and instructional guides for teachers. For example, how to conduct a class on map reading.
4. Getting students to search for relevant information to be used in their own research projects.
5. Connecting students through web-based chatrooms and forums. For example, students in different countries interacting to work on a project or to understand each other's culture.
6. Broadcasting a lesson live to different classrooms. For example, a Master Teacher can prepare and teach a specific lesson with the other teachers facilitating the learning activities in their own classroom.
7. In-service education and training for fellow teachers. For example, sharing by teachers on relevant teaching strategies.

These 7 ways to use ICT is not a homogenous list. It is really a mixture of ICT use for communication, presentation and research. They represent different degrees of teacher and student participation which imply a spectrum of active and passive

learning. The required pedagogical and ICT technical skills are profoundly different. Hence, it is not sufficient to only consider if teachers are using ICT but how they are using it and what types of ICT are being used, in order to understand the challenges that teachers face when implementing ICT in the classroom. Instead of researching on the availability of ICT equipment in schools as what Synder, Dillow & Hoffman (2009) did, it may be more useful to understand the different *ways* teachers are using ICT and to categorise them accordingly. The reason lies in the apparent similarity in pedagogical practices for each functional ICT category. Based on the literature (Zander, 2004; Harasim et al, 1995; Chapman, 2004; Staples *et al.*, 2005) discussed so far, it may be possible to type ICT resources based on how they are used as follows:

- To motivate the students (e.g. video clips to interest students in the concept)
- For presentational purposes (e.g. PowerPoint slides and broadcasting of information)
- For students to submit or present their work (e.g. using PowerPoint to showcase their research findings)
- To facilitate collaborations (e.g. chatrooms)
- For research (e.g. searching online for information)
- For interactive learning (e.g. learning games and research)

As informed by the literature review, these categories will be used to help structure the findings in the Results Chapter but at this point, it is important to state that these categories may not be exhaustive and more categories may emerge as a result of the study. The study will also attempt to uncover if the number of categories is manageable for teachers to apply in a coherent manner? The rationale behind using the categories of ICT use that have emerged from literature is a pragmatic one, so as to focus on areas which other researchers have found relevant. At the same, it must be emphasized that changes to these categories (either adding on or removing them) should not be discounted. These possible categories will be examined under 'Other Categories' in the Results Chapter.

Corresponding with these categories, it will also be useful to investigate if teachers have problems with specific categories of ICT use (Slay et al, 2008). It will also be

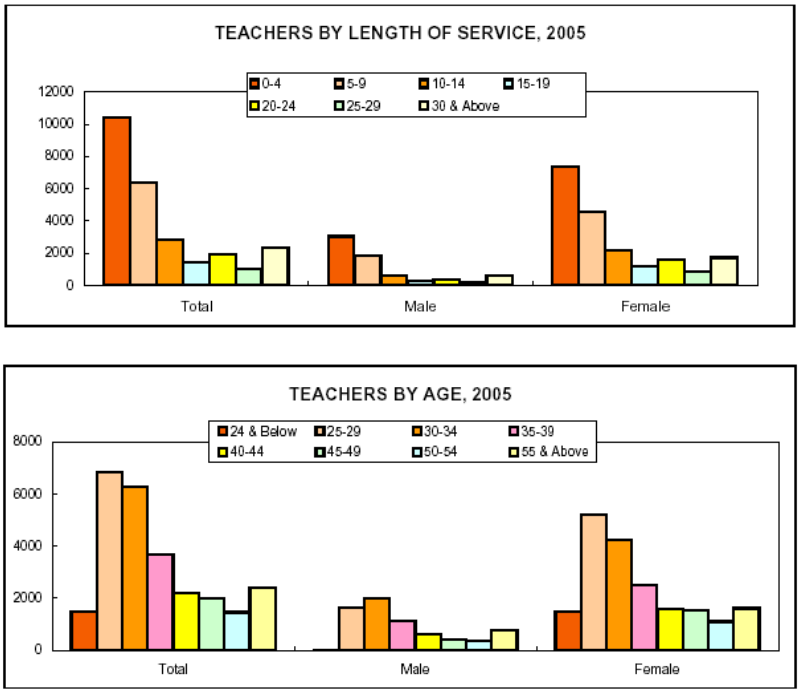
interesting to determine whether pedagogy or technology is posing the greatest problems to the teachers.

If it is technology, then it is possible that these teachers are not willing or unable to integrate technology into their teaching due to their *habitus.* According to Bourdieu (2004), *habitus* is a set of predispositions to appreciate or do certain things. One's early life experiences and nuclear family tend to shape a person's *habitus.* Belland (2009) argues that beyond a teacher's perceptions and attitudes, it is the teacher's *habitus* or early childhood experiences that shape the teacher's thinking and behavioural patterns which, in this study, refers specifically to the integration of ICT into teaching. He goes on to recommend changes to pre-service teacher training:

> *'According to the theory of habitus, then, teaching preservice teachers technology skills and letting them figure out how to integrate those skills into their teaching in innovative ways will not instil the disposition to integrate technology into teaching.'*
>
> (Belland, 2009:p.258)

Hence, according to Belland (2009), teachers who are already exposed to the benefits of technology at a young age are expected to possess a more favourable *habitus* to technology integration compared to teachers who are 'forced' to use technology by school management. Similar to Prensky (2005)'s concept of 'digital natives' and 'digital immigrants', Belland (2009) seems to suggest that choosing teachers with the right dispositions may work better than training teachers to take on the necessary skills without the right dispositions, the latter change being more cosmetic than holistic. While this assumption may be problematic and controversial given the flexibility of people in adapting to changes, there are grounds to justify Belland (2009)'s stand when viewed in respect to the teacher's exposure to ICT from young. Since younger teachers are also likely to be more frequent users of ICT compared to older teachers (Prensky, 2001), it is likely that they are more open to transfer this usage into the classroom.

In Singapore, a large proportion of teachers have less than 6 years of teaching experience (see Figures 2.7 & 2.8) with the majority of teachers in Singapore possessing between 0 and 4 years of teaching experience. They are usually in the 25 - 29 years old bracket. One reason for the young age profile of teachers is the high attrition rate of older teachers in recent years. In their study, Goh & Atputhasamy (2001:online) explain: **"t**wo main reasons why teachers leave the service are job stress and the lure of better monetary prospects in the private sector in time of economic upturn."



Figures 2.7 & 2.8. showing the number of teachers in Singapore by length of service and by age in 2005. (MOE, 2006)

With younger teachers, ICT implementation could be faster and more innovative but the lack of teaching experience may impede their ability to deliver an effective ICT-enabled lesson as they deal with issues related to classroom management and lesson planning (Mueller *et al.*, 2008). Experienced teachers, on the other hand, would have more time to focus on the ICT-related processes, having dealt with the basic issues of teaching and pedagogical skills earlier on in their teaching career. To a large extent, the ICT experience that young teachers have may be negated by the lack of teaching experience while the converse could be true for the older but more

experienced teachers who lack ICT experience but make up for it through their experience in classroom management (Rogers, 1995).

At this point, the two-factor consideration of pedagogical experience (Familiarity) and ICT experience (Facility) becomes even more evident. While ICT familiarity may correlate with the teacher's acceptance of ICT application and is indicative of the ICT skill he or she may possess (Belland, 2009), to be pedagogically competent is equally important in the ICT implementation process.

However, Watson (2001) argues, depicting teachers as being pedagogically incompetent or even techno-phobic and being reluctant to change may be counterproductive and misleading. Many of the teachers are not technologically incompetent but they just face barriers to ICT implementation. For example, Li (2007) identifies issues such as effective ICT access and curriculum pressure as problems that hinder teachers from using ICT effectively in their practice. The type of technology is also a determinant in influencing teachers to employ didactic teaching or learner-centred learning approaches (Becta, 2009). For example, presentational type of ICT (e.g. PowerPoint software) often leads to didactic teaching. Hence, the *interactional effect* of technology type (e.g. 'FaceBook') with pedagogical purpose (e.g. collaborative learning) is likely to be as important as the individual technology and pedagogy factors themselves. This issue of interactional impact has not been sufficiently addressed in the literature and warrants a closer examination, especially in relation to teachers' practice in the classroom.

2.4 Teachers' Practice (Transparency & Connectivity)

2.4.1 Transparency

While it may seem logical that the presence of ICT equipment in the classroom is a clear indication that ICT-enabled lessons are being conducted, not all teachers are actively using the ICT facility present in the classroom. According to Gülbahar (2007), the *process* of integrating technology (or 'transparency') is just as, or even more, important than the presence of technology in the classroom.

Slay *et al.* (2008) present a case study of how the attempts of teachers in three government schools in South Africa to use interactive whiteboards ended being less effective at teaching the lesson. The study highlights concerns about the use of the interactive pen technology (or Interactive Whiteboard) which was perceived to reduce active learning instead. These results point to a need for clear differentiation of technology types and the skills they require of teachers. Slay *et al.* (2008) further suggest that teachers need time to engage with and use the technology to suit their purposes.

> '*it may not be expeditious to attempt to "leap-frog" the use of interactive technologies*' but '*that an evolution of ICT related pedagogy is necessary to make optimal use of interactive pen technologies... and that teachers should be offered technologies, not have them imposed upon them.*'
>
> Slay et al. (2008:p.1321)

They also caution against technology transplantation (Tedre et al., 2006) by imposing technologies on teachers but that '*teachers be allowed to request the technologies they deem suitable to support their pedagogical evolution in the use of ICT in the classroom and offered concomitant training and on-going support'*. (Slay *et al*., 2008:p.1321). As such, a broader perspective beyond examining teacher's skill development as espoused by the Stage Theory (1997) is required. The technology transplantation may occur outside of the teacher's control and is often the result of school management's decision and the nature of the school culture.

However, infusing technology into the curriculum is not a straight-forward process. To masterfully integrate technology with curriculum requires thinking through the process and a deep understanding of the learning to be achieved. Some familiarity with the technology is also necessary to ensure it is aligned with the learning outcomes. Barnes *et al.* (2009) conducted a study examining the relationship between ICT and deep learning in a secondary school and a college. What they found was that while ICT appeared to enhance the enjoyment of the learning process, it did not always ensure that the learning was deep – students were still memorising texts rather than making in-depth analyses and comparisons. For

example, a law lecturer interviewed in the study explained that, although the students made good use of the ICT software, it did not foster the kind of learning required for this subject - the ability to argue and critique facts presented to them.

> *'… it is quite difficult to think of a way of interacting with the technology which allows them to discover those higher analytical skills … consider the implications of this case, how did it develop the law … It (ICT) won't help my students necessarily to develop the analytical skills that come from debate and discussion.'*
>
> *Law Lecturer (in Barnes et al., 2009:p22)*

On the other hand, a secondary school teacher reported success in getting her students to engage in independent work using a piece of software called 'Update'.

> *'Yes, they have to take responsibility and control over their own learning…. they are not used to it, they are used to spoon feeding... (The) Year 9 students did some research - they studied weathering of rocks and environmental chemistry, acid rain and so on. We used an Update activity…I see this as an example of deeper learning because they have taken the information, seen examples, had to interpret it. It is difficult to do.'*
>
> Science Teacher (in Barnes *et al.*, 2009:p11)

In the lessons by the Law lecturer and the Science teacher, technology was used to stimulate thinking and learning although in the first case, the students did not engage in the type of debate and critical thinking that the lecturer would like. There are many possible reasons for this, including the use of inappropriate ICT, unclear instructions by the lecturer and the need for certain skills to be trained through face-to-face interaction. The Science teacher, on the other hand, managed to get the students to collaborate and present a piece of work. While she termed it as deep learning, it is unclear how much evaluation and synthesis of information actually occurred for each of the students (Barnes *et al.*, 2009). Presenting information may not entail in-depth analyses but a rehash and rephrasing of the details provided to them. The challenge for both teachers is the same – to facilitate the processing, synthesis and evaluation

of the information in students to generate higher quality answers, which unfortunately did not seem evident for both groups even though the Science teacher appeared to be satisfied with the learning outcome.

Similar problems were uncovered in a study conducted by Gülbahar (2007) on the use of ICT in a Turkish private school. The study revealed that while teachers and administrative staff felt that they were competent in using ICT available at the school, they reported a lack of guidelines that would lead them to successful ICT integration. In other words, the issue was not about the lack of training on how to use the ICT equipment but rather 'transparency' – using ICT *in teaching*. Clearly, besides understanding ICT use, there is a need to understand how to integrate ICT into the curriculum for classroom use (Belland, 2009).

In this respect, Rogers' (1995) and Sandholtz et al. (1997)'s multi-stage models do not seem able to address the praxis of technology use where technology meets curriculum. Specifically, the studies by Slay et al. (2008), Barnes et al. (2009) and Gülbahar (2007) clearly highlight a need for ICT implementation models to go beyond treating technology as a single entity with singular purposes and goals.

A rather simplistic typology used by Maddux & Johnson (2005) based on ICT application provides some indication of how ICT applications can be categorised. According to their typology of ICT, Type 1 applications refer to computer usage that makes traditional (or didactic) teaching more efficient or easier. This includes using technology for rote learning (e.g. didactic instruction to train spelling or addition skills and PowerPoint slides). Type 2 applications, on the other hand, involve active participation by the user (or what is known as learner-centred or constructivist approach) and the focus is on developing thinking skills, creativity and problem solving abilities through ICT-enabled activities such as programming, simulations and word processing. Examples include interactive educational software and training simulation systems. Maddux & Johnson (2005) emphasise that technology use should be mainly Type 2 applications to maximise its potential in helping students learn. The new developments in social networking technology, interactive learning software, mobile learning technology and video technology suggest that the typology can go beyond the two types proposed by Maddux & Johnson six years ago. In

addition, ICT implementation models need to take into consideration the pedagogical skills required of teachers to implement the different types of technologies such as Web 2.0, social media tools and wireless networks which are currently still being explored by teachers in the classroom.

In addition to implementing ICT within their own disciplines, the Hypertext Model also examines how teachers utilise ICT to teach cross-disciplinary or cross-subject concepts – 'connectivity'.

2.4.2 Connectivity

The added difficulty for Connectivity compared to Transparency is that most teachers are subject teachers. They teach specific subjects and so, linking concepts across disciplines entails teaching outside of their domain knowledge and more importantly, outside of the scope of their teaching responsibilities. Hence, with tight timelines being a key constraint, most teachers do not attempt to go outside of the syllabus. In the literature cited so far, the implementation of ICT has always been within the scope of a particular discipline or subject. For example, a study by Voogt et al. (2004) examined how language teachers teaching French, German and Russian utilised ICT in their teaching. However, there was no mention of any attempt in connecting the various languages to enhance cross-language learning. It is also unclear how useful Connectivity as a concept is at this point in time, given that many teachers are still grappling with implementing ICT *within* their own discipline.

While this emphasis on taking broader perspectives of ICT integration is not new (e.g. the HyperText Model, 2007; Wells, 2007), the comprehensiveness of the models does not seem to have caught up with the prevailing technology and current practice. ICT reforms require school leaders to review issues using a broader framework in order to successfully integrate technology into classroom teaching. Schussler et al. (2007)'s Hypertext Model is an example of how a comprehensive model can provide schools with a useful 'fish-eye' view of the issues at stake. However, the Hypertext Model is unclear in how the different layers of Familiarity, Facility, Transparency, Connectivity and Collegiality interact to produce a coherent technology implementation plan. While it is useful as a tool to profile the ICT state of

a school, it lacks clear guidelines as to what the different profiles entail and how schools should act subsequent to knowing their ICT profiles.

2.5 Professional Development (Collegiality)

Unlike Connectivity, there are a number of areas that Collegiality addresses. Schussler et al. (2007) cites training on ICT for teachers and support for teachers from other school staff such as the principal and technical assistants as part of Collegiality. While Schussler et al (2007) do not include other areas such as positive school culture, pro-ICT management style, development of teacher leaders and having a technology plan, these are important 'manifestations' of the support from teachers and school management on the ground. Hence, these issues will also be discussed in this section.

2.5.1 Building a Positive School Culture

In his study, Bain (2004) noted one common feature of schools which failed in their implementation of ICT.

> *'The common feature that united these schools was that none had built a deep, cohesive school wide culture of classroom practice that could catalyse the development of genuine educational technology.'*
>
> Bain, (2004:online)

According to Bain (1996), establishing a positive school culture was the overriding factor that contributed to a successful ICT implementation. In his implementation of ICT at Brewster Academy, a private secondary school with about 350 students, where he was also the Deputy Head, Bain (1994) put in place several ICT-friendly practices (School Design Model). Described in detail in several studies (Bain, 2000; Dimmock, 2000), Brewster Academy does not seem to focus on ICT but rather on the day-to-day business of teaching and learning with ICT as one of the tools to facilitate that process of interaction among students, teachers and school administration. Described in Bain's (1996) article,

'The 1996 Brewster represents a total technological transformation from the 1992 scenario…Students and teachers don't use computers a few times per week, rather, they use custom and application software with laptop PCs the way they formerly used books and pencils…Teachers integrate technology into their teaching and use it seamlessly on a day-to-day basis in their classrooms.'

Bain (1996:online)

By incorporating technology into the daily interactions of the school according to the needs of the teachers and students, the transition to ICT usage was smoother. ICT was added on to provide a technological avenue to extending the social interactional networks among the staff and students.

However, the start of the culture building process was difficult for the school as teachers who disagree with the ICT developments leave the school. Eventually, new teachers with pro-ICT beliefs and philosophy joined the school, thereby contributing to the ICT-friendly school culture over time. The study shows the importance of school leadership in setting up this cohesive ICT culture in the school. The experience at Brewster Academy provides some evidence that with support from the school leaders and a pro-ICT school culture, teachers can be empowered to implement ICT in the classroom.

2.5.2 Management Style

The way school leaders work with teachers affects the level of cooperation they would in turn get from the teachers (Gipson, 2003). While Granger *et al.* (2002) found principals with positive attitudes towards ICT use in their study are more likely to cascade these positive attitudes down to their teachers, the manner these attitudes toward change, notably, ICT use in the classroom, are transmitted would depend to a large extent on the approach the school management takes in supporting, convincing and encouraging the teachers to adopt ICT in the classroom. Underpinning this 'buy-in' from the teachers is a lot of communication between the school management and teachers, a high level of trust that leads to autonomy and

liberty for the teachers to try new initiatives in the classroom. Factors that can lead to 'buy-in', for example strong management support and a clear vision from the principal are well-documented (e.g. Chapman & Mahick, 2004; Bain, 2002). However, the precise mechanics and processes of what the principal does with his or her staff remains an enigma. The literature is somewhat silent on the specific measures and process principals take to initiate and maintain this 'buy-in'. For example, how do principals interact with his or her staff to ensure 'buy-in'? What do principals do on a daily basis to encourage ICT use?

Foo, Fan, Lee & Bawani (2001) studied how two Singapore principals, one the initiator of the ICT reform and the other his successor, impacted Xinmin Secondary, a Singapore government school by adopting different approaches to culture setting. The first principal initiated reforms to raise the popularity of the school and in doing so, also raised the academic performance of their students as better students enrolled into the school. The succeeding principal implemented further reforms by encouraging innovation and creativity within the school. He put together a group of 'IT foxes' or teacher leaders to spearhead ICT initiatives. Interestingly, like Brewster Academy, (Bain, 2002), Xinmin Secondary had reforms which were non-ICT related at the beginning and moved on later to include the use of ICT (Foo *et al*., 2001).

From the study, it is clear that both principals took pains to build a strong and supportive culture by providing financial, infrastructural and emotional support. They also focused on a culture of excellence and innovation before delving into the specifics of ICT reform. As such, the pro-ICT culture and supportive environment led to an easier and more effective ICT reform process. For example, confidence-building activities (such as sharing success stories) provided the stimulus for teachers to try new and innovative strategies in the classroom (Mueller *et al*., 2008). Strong teacher involvement in the initial stages of ICT development in school would provide greater degree of adoption by teachers later on and these would form what Rogers (1995) would term as the early ICT adopters in school.

2.5.3 Empowering Teacher Leaders

The importance of getting senior teachers or teacher leaders who are early ICT adopters to facilitate and operationalise the change is well-documented (e.g. Hobson, 2009; Harrison & Killion, 2007). Staples *et al.* (2005) highlight the importance of giving autonomy to these teacher leaders in school based on three reasons.

Firstly, principals themselves are unlikely to possess all the necessary technology expertise required to drive ICT initiatives in the classroom. Secondly, the typical classroom teacher will be able to identify with this teacher who can support the less ICT-experienced teachers (Hobson, 2009). Harrison & Killion (2007:p.75) found that

> *'…when teachers learn with and from one another, they can focus on what most directly improves student learning.'*

Thirdly, with autonomy, these ICT-experienced teacher leaders can help shape the technological development in school. As Hobson (2009) found in his study with beginning teachers, teacher leaders exert a huge amount of influence over the less experienced teachers and this includes the implementation of ICT in the classroom.

2.5.4 Quality ICT Training

Besides empowering teacher leaders, teacher training is also a key factor in ICT implementation. Voogt et al., (2004) concluded that it is not sufficient to only upgrade the hardware if teachers are unwilling to be trained. Chapman (2004) commented:

> *'A common element across all these innovations is that, in order to effectively use such technologies, teachers sometimes have to learn new knowledge and skills, spend more time for lesson preparation, and engage in different types of conversation with students.'*
>
> (Chapman, 2004:p.24)

Teacher training can provide an additional boost to ensure successful practice occurs within the classroom with ICT implementation. Without which, it is not realistic to require teachers to know what to do without being taught. Mueller et al. (2008) advocate schools to get teachers to focus on building confidence and positive attitudes during ICT implementation phases. It will also aid in changing teacher's perceptions to ICT.

However, for private schools in Singapore where funds are limited and ICT equipment is less available to teachers and students, ICT training is likely to be ignored by management. It is not uncommon to know of private schools in Singapore closing down due to financial constraints and cashflow problems (CNA, March 10, 2009). The lack of funds naturally implies that private schools would focus on marketing and increasing student enrolment over teacher training. A report by the Ministry of Trade and Industry (MTI, 2002:p.3) seems to substantiate this point '… it is observed that teacher quality varies greatly among schools with most teachers employed on a part-time basis." Private school teachers are also not given the option to join the teacher training programme at the National Institute of Education (NIE) although they are allowed to participate in the Masters Programmes which do not focus on the 'operations of teaching' but rather on the philosophy and rationale of different pedagogical issues. As a result, many private school teachers in Singapore lack professional teaching qualifications. As stated on the website of the Ministry of Education (MOE), Singapore (2010:online),

> *Private school teachers should possess educational qualifications beyond the levels the private school has proposed for them to teach. Their qualifications and knowledge should be related to the subject areas to be taught.*

With the only requirement being a qualification higher than the level they are to teach at, private school teachers are not required by legislation to possess teaching qualifications or experience. Coupled by the fact that many of these private commercial school teachers in Singapore are also part-time teachers (MTI, 2002), training may be of utmost urgency for many of these private school teachers, so that they have the relevant pedagogical skills to use the technology effectively.

2.5.5 Technical Support

Technical support, a component of Collegiality, relates to assistance given to teachers such as resolving software issues, infrastructure support and hardware acquisition. Technical support, interestingly, is given by ICT technical staff as well as relatively ICT-competent teachers who act as ICT teacher leaders in the school (Staples *et al.*, 2005).

According to Zander (2004), teachers in German schools have to maintain ICT equipment and solve technical problems on their own without technical support. The interesting result is that teachers become adaptable and independent at solving ICT problems in a creative manner.

2.6 Interaction among the Teachers and Technology in School

Perhaps the strongest theme to emerge from the literature review is that ICT implementation is a complex process and involves a myriad of different factors which include teacher attitudes, level of communication, support among the teachers, ICT infrastructure and teacher training.

The notion that teachers, despite being trained, are employing ICT in an ineffectual manner is discomforting (Slay et al., 2008). It makes one question if the issue is with the teacher or the technology. Could it be a case of inappropriate technology being selected for implementation in the classroom?

2.6.1 Using the Right Technology

With teachers in private schools being under-trained and possibly ill-equipped to handle ICT, school leaders need to consider the type of technology suitable for use, both in terms of cost and the pedagogical skill required. Work by Maddux & Johnson (2005) and Gibbons & Fairweather (2000) shows that ICT which are curriculum-based and targeted at Type 2 applications tends to achieve good returns on the investment, in terms of learning efficacy. One source of ‘cheap’ and available

technology which should be considered involves the students' personal mobile phone and computers.

With a range of technology in their pockets and bags, students are equipped with mobile phones, music devices and laptops (Domitrek & Rabv, 2008). Domitrek & Rabv (2008) argue that if school leaders were to give greater freedom to teachers and students on the use of ICT (including mobile phones) in the classroom, it would present more opportunities for teachers to utilize ICT in a more effective manner. For example, mobile phones could be used to access the internet or to receive video clips via Bluetooth software and send Short Message Service (SMS) to indicate their responses to quizzes before or after a lesson (Rau, Gao & Wu, 2008).

2.6.2 Risks and Pressure

On the other hand, teachers face considerable risk in utilizing ICT (Staples *et al.*, 2005). Poor application of expensive ICT equipment leading to ineffective lessons and equipment malfunctions are risks teachers take when adopting ICT in class. Staples *et al.* (2005) suggest that schools start small in gradual steps to provide a safe environment for the teacher to experiment at low cost.

Fullan (2001)'s innovation dissemination theory lists *trial and cost* as one of the six characteristics which determine the extent innovation is accepted and adopted by the users (teachers). By allowing teachers to try an innovation in small increments before making a major commitment, risks can be contained and this is something not mentioned in many models (e.g. Mueller et al., 2008; Domitrek & Rabv, 2008). *Cost* is a major factor in determining if innovations are supported for the long-term since recurring costs are always difficult to justify. Hence, it is important to ask if teachers and school leaders feel pressured to ensure a return on investment for an expensive resource (such as computer terminals or software). To some extent, an innovation that is high in *cost* implies there is no *trial* and no room for it to fail. Possibly, the last thing a teacher wants, besides being held accountable for the students' grades, is to be blamed for not implementing an initiative successfully. It is unclear from the

literature if the additional psychological fear and pressure actually put teachers off ICT use. However, as reflected in Fullan's (2001) innovation dissemination theory, trial and cost warrant some attention for effective ICT implementation in schools.

In relation to the issue of managing risk and pressure, Chapman *et al.* (2004) question the logic of adopting top-down approaches to ICT implementation.

> *"Often the introduction of technology is undertaken as a top-down innovation in which the Ministry of Education initiates the effort and then tries to persuade teachers to use the new instructional strategies. Many argue that this is the Ministry's role and responsibility, especially when the technology being introduced is expensive …"*
>
> Chapman *et al.* (2004:p.29)

The extent to which the top-down approach increases stress and aversion levels for the classroom teacher is unclear but inevitably, school leaders play a crucial role in ensuring the change process is effectively carried by providing sufficient support to the change implementers – the classroom teachers (Chapman & Mahick, 2004).

2.6.3 Designing a Technology Plan

To maintain a clear focus on the final outcome for the school, an effective technology plan is essential to draw the individual initiatives and strategies together (Baylor & Ritchie, 2002). The importance of having a plan is also emphasised by Conlon & Simpson (2003:p.150),

> *Teachers were hastened into cyberspace without sharing any clear educational vision of change. The result is that schools have been rewired but schooling has not been significantly transformed.*

As the type of technology affects the mode of instruction directly, decisions about the choice of technology would impact the degree of integration and the quality of learning in the classroom, as illustrated in the case studies about ICT and deep learning (Gülbahar, 2007).

In this respect, the models proposed by Rogers (1995), Sandhotlz (1997) and Schussler *et al.* (2007) fall short of the requirements of a technology plan. None of the three models indicate comprehensively the steps to take to implement ICT in school. While they serve to provide descriptions of teacher types (Rogers, 1995), ICT progress phases (Sandhotlz, 1997) and multi-dimensional factors affecting ICT implementation (Schussler et al., 2007), these models do not recommend any implementation approaches for schools. More importantly, they do not suggest how schools should customise their approach based on their own needs analyses.

Findings from the Becta Survey (2009) with 831 schools in the United Kingdom indicate that 9 out of 10 schools have a written ICT strategy or improvement plan.

> *Within these plans, the most frequently identified item is the replacement of equipment, with three-quarters of senior leaders mentioning this. Other elements…are continuing professional development for teachers, investments in the school ICT infrastructure, use of the learning platform, e-safety, and the acceptable use policy.*

While the high percentage of schools with technology seems promising, the strategies listed in the technology plans reported above would fall short of the requirements of a good technology plan based on the literature discussed so far (e.g. Gipson, 2003; Staples *et al.*, 2005; Barnes *et. al.*, 2009). The reasons are primarily pedagogical in nature. School leaders need to go beyond the role of only providing or replacing resources such as ICT equipment, training and technical staff to manage the infrastructure. They have to understand how ICT can be integrated into curriculum and provide strong leadership through a curriculum-based reform approach. In this regard, the manner in which ICT is integrated into the curriculum is not reported by principals as part of the technology plan and this is an area of concern which should be addressed.

Going forward, what would then be a suitable technology plan for schools leaders to follow? Pospisil and Willcoxson (1998) propose three core models of institutional development for online teaching:

- **Anarchic Development**: where the educational institution leaves it to the individual's interest and capacity with educational technology to determine what online development occurs (i.e. the institution sets no strategic priorities)
- **Negotiated Development**: where the institution's decisions and priorities on ICT and the choice of instructional design models are dependent on individual or small group interests
- **Controlled Development**: where the institution maintains control over the resources by ensuring decision-making processes occur at a high level in the institution

According to Pospisil & Willcoxson (1998), the least cost efficient of the three models is the Negotiated Development model since conflicting demands between individual enthusiasms and centralised planning by the institution may lead to investment of resources in areas that do not give any long-term strategic advantage for the institution.

This study was conducted in the late 1990s and with technology being upgraded at exponential speeds, the recommendation to adopt a long-drawn developmental process through 'Controlled Development' becomes questionable as the technology may be already outdated by the time a decision is finally made. The dilemma appears to be whether schools keep waiting for technology to be cheaper and better before it is adopted or should schools take on whatever technology is available, knowing that there is always something better along the way. The 'technology deflation' experienced by schools is counterbalanced by the pressure to use technology for enhancement of the learning process at the moment in time. For an Asian culture such as Singapore where negotiation remains a highly acceptable part of decision-making, whether 'Negotiated Development' is a more palatable preference for schools needs to be examined. As such, Pospisil & Willcoxson (1998)'s conclusion needs to be questioned in our current fast-changing world.

It is also questionable if the Hypertext Model is suitable as technology plan or should a more inclusive model examining the 'best fit' between teacher profile and technology type be more appropriate. While the Hypertext Model provides a useful framework for comparing factors such as pedagogy and school environment, it is unable to point out authoritatively the types of technology which may fit well with certain teachers or school profiles. The nature of technology-teacher fit is not clearly described.

This study aims to provide some steps or possible measures that private commercial schools can adopt to implement ICT in their schools. If a clear understanding of the major issues and perceptions relating to the three sets of actors (teachers, leaders and technical staff) can be clearly articulated, a workable approach to ICT implementation can then be clearly established for these private schools to effect change in a more sustainable and cost-effective manner.

2.7 Conclusion

ICT represents a major investment risk for schools. The costs of ICT equipment and building infrastructure can be prohibitive. However, while many schools may not be able to afford the latest trends in computing technologies, they may still want to employ some technology in the classroom to enhance learning and teaching. The lack of understanding on how ICT is to be implemented is usually compounded by budget constraints which limit what schools can actually do. Until a clear plan to integrate ICT into classroom teaching is available, most private schools and teachers with limited budget, may not want to jump onto the technological bandwagon but remain as the "late majority" (Rogers, 1995). In the next few years, the use of new technologies for interactive and engaging forms of use may become more prevalent, not just in the classroom but also for social and communication purposes. Teachers in the 'late majority' group would have to move by then or risk being left on the sidelines of ICT advancement.

This literature review has provided a structure which highlights the roles of the different actors in schools and the obstacles they face as well as pose to the implementation of ICT in schools. The review has also exposed a whole host of problems that teachers and schools face when implementing ICT from the lack of ICT infrastructure to financial difficulties to a shift in teaching and classroom management approaches. On the whole, the literature highlights a highly complex relationship between teacher skills involving both technology and pedagogy and the level of ICT being implemented in the classroom. This relationship between teacher skills and level of technology utilised appears to be key to the ICT implementation process.

With this in mind, it is also to be expected that the dimensions in the working model may vary somewhat from those in the literature. With a predominantly Asian cultural background, teacher beliefs and attitudes in Singapore are different from those in Europe or Americas. The resultant model would reflect the uniqueness of the Singaporean context and the values our teachers place on education and innovation through the use of ICT.

From the literature, there are some key areas which will help guide the formulation of the resultant model. The work of Staples *et al.* (2005) and Luke *et al.* (2005) are instrumental in shaping the notion that technology use in the classroom is multi-faceted and requires further categorisation. As mentioned in the earlier sections, technology use can be examined in the light of its use from motivating students to presentation purposes to production (of answers) to collaborative and experiential learning. Hence, as discussed (on page 26), ICT can be typed according to its use as:

1. a motivational tool
2. a presentational tool
3. a production tool
4. a collaborative tool
5. a research tool
6. an interactive learning tool

This denotes a transition from a relatively passive role to a more active learning role for the students in the classroom. As a result, learning generally becomes more constructivist in approach. However, this transition only relates to how ICT is used. It does not take into account the non-ICT segments of the lesson and whether teachers actually adopt constructivist approaches then. The extent teaching methods differ between ICT and non-ICT segments will also need examination.

Secondly, the type of technology being utilised changes as ICT use shifts from motivational to presentational to production to collaboration and finally to experiential learning purposes. The studies by Slay *et al.* (2008) and Barnes *et al.* (2009) seemed to indicate different types of technology required for the various purposes. The former study involved the Interactive Whiteboard technology for presentation purposes while the latter involved forums and customised software for learners to engage in collaborative and experiential learning. While it is unclear how the technology requirements change with the transition, it seems that collaborative and experiential learning would require at least individual response pads or computers for every student in order for the student to be engaged individually.

The shape that this study seems to be taking is to explore how the five dimensions in the Hypertext Model seemingly interact across different functions of ICT use. The question of a possible ‘best-fit’ among the dimensions for schools to implement ICT effectively needs to be addressed.

CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY

3.0 Introduction

As described in Chapter One, this study seeks to understand the perceptions of teachers, school leaders and technical staff with regards to how ICT is developed and implemented in a private school in Singapore. The approach has to help "clarify and understand phenomena and situations when operative variables cannot be identified ahead of time or to understand how participants perceive their roles or tasks in an organisation" (Merriam, 2005 p.1). The selected methodology must contribute to "better understand a phenomenon about which little is yet known" (Hoepfl, 1997:p.48). In this regard, it is unclear how teachers keep up with the young in using new technologies in the market which may include FaceBook, Twitter and YouTube. A strange paradox develops where school is perceived as dated with boring paper-and-pencil tasks while students engage in exciting and innovative media such as interactive games consoles (e.g. the Wii), home-made video clips, electronic mail and personal blogs at home or in game arcades.

With this as the context, schools and society face a dilemma of how to move with the times whilst maintain a focus on the learning process. The approach that private, commercial schools in Singapore adopt is important if Singapore is to develop into an educational hub for the region, especially within the confines of recent legislation for the private schools.

3.1 Research Aims and Questions

The constantly changing ICT landscape makes it difficult to ascertain if ICT-related measures taken by schools are effective and even if they are effective, whether they remain effective over time.

Based on the literature research, teacher perceptions and attitudes, the way in which the teachers and school leaders communicate over the ICT implementation policy and the extent to which the teachers are supported in the use of ICT seem to stand out as key issues in determining the success of ICT use in the classroom.

Furthermore, given the limited resources and financial constraints that private, commercial schools face in Singapore, how should these schools go about establishing an ICT framework? What is a possible model that these schools can adopt? This study aims to examine the perceptions and interactional patterns of teachers, school leaders and technical staff in the implementation of ICT in a private school and how these are linked to the success or failure of specific ICT approaches in Singapore private schools.

The five research questions listed in Chapter One are designed in such a way as to progressively extract and analyse the information which would contribute to the understanding of the main research question. The specific research questions will be re-examined here to discuss how they are linked with each other and with the main research question.

	Specific Research Questions
1.	What are the teachers' and school leaders' perceptions towards the use of ICT in the classroom?
2.	What are the teachers', school leaders' and technical staff's perceptions towards the available ICT infrastructure in Cool School?
3.	How do teachers and school leaders view the link between technology and teaching?
4.	How do the management and teachers collaborate to implement ICT initiatives in the school?
5.	What are the teachers' and school leaders' perceptions towards the ICT policy in Cool School?

The first three research questions are designed to be general enough to guide a preliminary examination of the perceptions of the three main areas of ICT use in the classroom, ICT policy and the available ICT in the school. This initial examination will yield issues which require further questioning and study. Since there are very few, if any, studies on private commercial schools in Singapore concerning the use of ICT, the possible variables which could arise from these three research questions could

be unforeseen and interesting. As such, having these questions will be useful to help set the direction for the rest of the study.

In addition, these three questions are heavily influenced by the literature research, some of which is described in Chapter Two. These issues relate to the difficulties teachers face in implementing ICT in the classroom, the need for a technology plan and a strong ICT infrastructure.

While the first three questions concern the perceptions of the individual actors towards ICT, the fourth question examines the manner of interaction among the actors in the school. Mapping these interactions would provide school leaders with a useful guide on how to work with and utilise key personnel, including teacher leaders, for ICT-related initiatives. The manner in which school staff are managed, encouraged and allowed to innovate could determine the amount of staff support for ICT projects. From the literature, the leadership provided by the principal has a huge bearing on the effectiveness of ICT implementation in schools.

The fifth research question focuses on the link between ICT policy and teaching. In short, it is about finding out the types of ICT policies which encourage or hinder innovation practices and implementation.

Summarised in Table 3.1., data from teachers, school leaders and technical staff on the five specific research questions (SRQs) will be collected and measured:

Research Question	Perceptions	Teachers	School Leaders	Technical Staff	Data Collection
1	ICT in the classroom	✓	✓	✓	Interviews
2	ICT infrastructure	✓	✓	✓	Interviews & Environment Scans
3	ICT & Teaching	✓	✓	✓	Interviews & Web blogs scans
4	Collaboration approach	✓	✓	✓	Interviews, Qualitative Surveys
5	ICT policy in the school	✓	✓	✓	Interviews

Table 3.1. Data Collection Methods and Subjects for the SRQs

Having defined the research questions, the approach in conducting the research study needs to be determined. The strengths and limitations of the various paradigms and approaches will be examined to find how best to conduct the study.

3.2 Epistemology and Ontology

A review of the literature (e.g. Dixon-Woods *et al.*, 2007; Bryman, 2007) shows conflicting viewpoints about reality (ontology) and how knowledge is constructed (epistemology) and perceived. The various paradigms that arise from this conflict have resulted in different approaches to the investigation of reality (Bryman, 2007). Essentially, there are two epistemological approaches that most researchers adopt – positivism or interpretivism. The positivistic approach is closely aligned with the key tenets in natural scientific enquiry, namely, only phenomena and knowledge that can be confirmed by senses can be accepted as theory and this is then tested to explain natural laws. A key assumption of the positivistic approach is that observations through senses would provide the most objective (value-free) result. Notions of objective experimentation and quantitative data collection are methodologies that reflect this positivistic and supposedly more objective way of research.

Most positivistic researchers (Shaddish, Cook & Campbell, 2002) argue that a clearly observable phenomenon is stronger than one that is conjured, hypothesized or lacking in systematic clarity. The positivist paradigm focuses on gathering information based on observational powers according to one's 'senses'. Scientific principles such as replicability, validity, reliability and generalisability are important in positivistic research.

Positivistic research is meaningful when it is coupled with the notion of objectivism since objectivism provides the notion of reality which assumes that social phenomena are external facts that are beyond our influence as social actors. With this assumption, objectivism allows positivistic researchers the basis to conduct research on social entities on the premise that the observations are 'untainted' by subjective or individualistic actions - a single 'truth' which is immutable.

If without the assumption of objectivism, positivistic research cannot be considered definitive but rather temporal since the subjective nature of individualistic actions and social constructs would influence observable phenomena such that any observations made would be true only at that point in time. It would render positivistic research 'powerless' to build theories that can withstand the test of time.

Nonetheless, positivistic research, with the underpinning assumption of objectivism, is highly regarded in physical and biological sciences where tests generally can be repeated, observations measured accurately over time and the "language precise" (Paul & Marfo, 2001:p533). However, this emphasis on statistics and analyses can sometimes result in positivistic research suffering from an over-reliance on using numerical data to formulate theories and meaning-making. Its application in educational and social science research where social constructs are less defined, statistics-based and objective (Winn, 2003), is decidedly more complicated. There are studies whereby the research matter requires in-depth investigations of complex social systems (such as interactions of environmental factors with human cognitive, emotive or social elements) which tools based on sensory observations may not be sufficiently complex to measure the nuances in the differences. Some social scientists (Sigel *et al*, 1992) would propose the alternative, interpretivism, as a more suitable epistemology to such research.

Interpretivism is an epistemology which takes into account the differences between the social (human) and the natural worlds (Guba, 1990). By emphasizing the subjectivities in human research, interpretivism has at times been a more useful approach to capture the subliminal differences in interpreting human cognition and perceptions (Hermeneutics) and how humans make sense of the world around them (Phenomenology).

Since interpretivism focuses on differences between people and objects, the underlying ontology would likewise need to attribute phenomena and knowledge to human subjectivities and actions. Also known as constructivism, this ontology provides a platform for social scientists to examine reality as a 'reconstructed' concept based on human perceptions. Constructivism highlights the importance of human actions since reality only makes sense when perceived through the eyes of

the human actors or observers. This approach gives some leeway in allowing researchers to examine 'illogic' and 'unpredictable' human actions as a legitimate study which positivistic research would find difficult to account for.

3.3 Paradigm Choice for Educational Research

Unlike typical experiments involving the 'hard sciences' like Chemistry or Physics, educational research does not have the luxury of controlling for variables. Variables such as family background, teacher characteristics, educational systems, cultural, religious and language factors play very important roles in determining the success or failure of educational interventions. As a result, some researchers (e.g. Botha et al, 2005; Reeves, 2000) have questioned this lack of rigour during the execution of the research. Finding the balance between what is practical and what is of value is difficult especially in educational settings where researchers have to follow the schools' schedule and observe the rules set by the teachers in the classroom.

Compared to quantitative research, qualitative research focuses less so on numerical or statistical data and more on understanding the phenomena in "natural settings" (Hoepfl 1997). According to Botha et al. (2005:online), 'many scholars are of the opinion that research in education should be based on qualitative data' due to the numerous field variables involved.

3.4 Rationale for Using the Interpretivist Paradigm

The nature of the research question and aims of this study requires a detailed examination of how the teachers, leaders and support staff perceive ICT and ICT policy in the school. There is an element of social, cultural and psychological influences that underpin each person's perception that needs to be researched. Coburn (2003) emphasised the need to examine different layers of depth pertaining to the *norms of social interaction* and at a deeper level, the *underlying pedagogical principles* when reviewing reform initiatives. A relatively long-term engagement, interacting and working with each teacher and school leader may be necessary, in order to extract internal cognitive and psychological processes and to understand the

complex relationships that each teacher and school leader exhibits in school, in relation to ICT use.

As mentioned earlier, the positivist epistemology lends itself better to the quantitative methodology where collection of figures and data would be an essential part of the approach. Interpretivism, on the other hand, is an epistemology that accounts for the subjective differences between the social (human) and the natural worlds (Guba, 1990) in a relatively limited context. In other words, by emphasizing the subjectivities in human research, interpretivism can be useful in capturing the subliminal differences when interpreting human cognition and perceptions of the private school teachers in Cool School as compared to positivist research.

Given the emphasis on the social and cultural elements of the environment, the interpretivist paradigm where the interactive nature among the three actors and the environment is an area of importance would better fit the nature of the study. The perspectives of the actors and the relationships among them form a key part of the research focus and this is consistent with the ontological assumption underpinning the interpretivist paradigm that social reality is constructed based on interactions between actors in a setting or context. As a result of the focus on the teachers' personal thinking processes, belief systems and experiences and the specificity of the private school culture, the study does not intend to generalise the findings to other schools as there are not many schools with exactly the same culture and teacher profile.

3.5 Using a Case Study Approach

Qualitative research comprises many different methodologies. A close examination of the nature of the research questions requires the study to explore the underlying issues concerning the teachers' perceptions of using ICT and the interactions among the school leaders and staff during the implementation of ICT initiatives. Coburn (2003:p.5) argues that 'increased emphasis on depth as a key element of scale calls into question the degree to which classroom implementation can be assessed using survey methods alone'. While utilising survey methods may be effective for data collection of representative samples in quantitative studies, it would not be sufficient

for the purpose of the current study where in-depth analyses of the processes are required to make meaning of the data. This is in line with my argument that an interpretivist approach is a more appropriate one, considering the research objectives require the examination of the socio-psychological factors affecting teachers within the school context.

According to Yin (2009: p.2), case studies are the preferred strategy if the research satisfies three conditions: "when 'how' or 'why' questions are being posed, when the investigator has little control over events, and when the focus is on a contemporary phenomenon within some real life context". Beyond the 'what' questions, this research is really about processes ('how') and the reasons ('why') behind specific observed phenomena, especially those which make Cool School unique and outstanding in the private school industry. While this research will eventually inform the school on processes to drive the ICT initiatives further, the research is not just about how to implement ICT but it also gets into understanding the perceptions and emotions teachers experience when implementing ICT in the school. Given such a background, the study appears to satisfy all three conditions set by Yin (2009) on using case study as the approach for the study. To a large extent, Cool School stands out among the hundreds of private school in terms of its excellent academic results and its focus on helping delinquents to turn around. This uniqueness makes it a highly suitable candidate for the case study approach. According to Ellinger, Watkins & Marsick (2005:p.330), the use of case studies is especially appropriate when 'the researcher is interested in process or seeks an in-depth understanding of a phenomenon because of its uniqueness".

It is also because of the unique characteristics found in Cool School that lead to its basis for the research being a single case study. Yin (2009:p.47) justifies the use of a single case study 'where the case represents an *extreme* or a *unique* case'.

While it is difficult and subjective to label any school as unique, Cool School's characteristics: award-winning principal and teachers, students who were school dropouts, drug users, prison inmates and suicidal and, obtaining 'O' Level results that are above national average should qualify it as 'unique'. There are unlikely to be many schools with students of such a challenging background and attaining such

excellent turnaround results. These characteristics will be further elaborated in a later section.

The single-case study approach is focused and allows in-depth exploration of the issues, within the limitations of resources available. Re-visiting the single case in an iterative manner is an integral part of the methodology which in multiple case studies could be difficult and time-consuming. The main disadvantage of case studies is the limited generalisability of the findings as compared to other approaches, for example ethnographic studies (Chatterji, 2002). However, generalising the findings is not necessarily the objective of this study. It is primarily to build a possible working model on ICT implementation for Cool School which would eventually require further testing in other private schools.

Having established the rationale for the single-case study approach, it is also important to note that there are two types of single-case study: holistic and embedded designs (Yin, 2009).

In “classic case study research, the case may be an individual, where the individual is the primary unit of analysis. Case study research may also be done on several individuals, or it can be an event or entity that is less well defined than a single individual.” (Ellinger et al., 2005:p.328). The former as described by Ellinger et al. (2005) constitutes the holistic design while the latter, the embedded design. In the holistic design, the unit of analysis would be the case (the individual or organisation) while the embedded design refers to a single case made up of units (e.g. individual teachers) found in the case (e.g. a school). However, the analysis is made at the level of the units (teachers) and how these units interact to contribute to the culture or context of the case (school). The embedded design seems to match the requirements of this study since the manner in which the teachers (units) interact with each other and the school leaders is the focus of the study. One major pitfall, as highlighted by Yin (2009:p.52) is ‘when the case study focuses only on the subunit level and fails to return to the larger unit of analysis’ which is the school as an organisation.

The boundaries for the case (Cool School) will be drawn among the teachers, school leaders and technical staff (as units of analyses) where a more detailed examination can be conducted for each unit. The relationships among the units will also come under scrutiny within the larger case study framework. These relationships and intricate links between perceptions and behaviour will have to be closely examined in the context of the school culture. The extent to which the school culture is an influencing factor on the teachers' perceptions and attitudes towards ICT use in the classroom will present a highly interesting topic for further examination. To avoid the pitfall as stated by Yin (2009) of over-focusing on the individual teachers (units), the study will devote a substantial amount of resources and space to analyse findings of the relationships among the teachers and school leaders, and the contribution of these actors to the overall Cool School culture.

It is likely from the manner in which this study is developing, that the focus will be on searching for patterns and trends in the data, culminating in the formation of a hypothesis, thereby pointing towards a more constructivist approach to case study research.

3.6 Sample

3.6.1 Sampling strategy: Purposive sampling

Unlike quantitative research, qualitative research utilises non-probability sampling as its' goal is not to produce a statistically representative sample or draw statistical inference through hypothesis-testing. Instead, a non-random sample is chosen for its information-rich cases which can be studied in depth (Patton, 1990). With a purposeful non-random sample, the criteria used to select the participants are more important than the number of participants examined. In fact, the phenomenon needs to appear only once if the study is thorough and well conducted.

In addition, Flick (2002) states that:

> *What is decisive for choosing one sampling strategy over the other is whether it is rich in relevant information. Sampling decisions always fluctuate between the aims of covering as wide a field as possible and*

> *of doing analyses that are as deep as possible… Considering limited resources (human power, money, time etc.) these aims should be seen as alternatives rather than projects to combine*
>
> Flick (2002: p.87).

To select a meaningful and useful sample for this study requires a fair amount of networking skill and a high degree of flexibility on the part of the researcher. This became apparent to me when I attempted to conduct a pilot study to examine the key issues involved. The initial proposal was to work with government schools. Of the 8 government schools which I have been working very closely with for the past 3 to 4 years on learning style projects, only 2 responded positively and of the 2 schools, one school limited my collection of data to surveys and no interviews. The remaining school principal was keen to get her school's ICT projects off the ground and saw this study as a good opportunity to measure the progress of these projects. However, even with the principal sending out a personal email to get teachers to participate, the response was lukewarm with 6 out of 50 teachers agreeing to participate. Even among these 6 teachers, a few withdrew from the study after realizing that most of their colleagues were not participating in it. With these mounting difficulties, I realized that I would not get the cooperation from teachers in the government schools and knew I had to change my focus to something more manageable and less administratively complex.

3.6.2 Shifting Focus to Private Commercial Schools

Hence, the research objectives of the study were reevaluated. Keeping to the same topic of interest, the focus of the research was turned to private schools instead. There were several compelling reasons to shift the context of the study from government to private commercial schools. As highlighted in the introduction, Singapore is re-inventing itself as an educational hub and the recent school closures due to substandard school quality has led the Singapore government to legislate the industry in order to reform private education (APSC, 2009). The findings of this study will provide private schools with alternative perspectives on improving their teaching standards through ICT use in the classroom. The second compelling reason is that in contrast to the increasing pool of research conducted on government schools, the glaring lack of research literature on Singapore private schools is alarming. Needless to say, research of ICT use in private schools is practically non-existent.

Going forward, a few advantages of using private schools for this study have emerged along with the progress of the study. One is the lack of top-down management and regulations from the Ministry of Education which permits greater creativity and liberty for principals to attempt new approaches in the school. Principals and teachers are also more sensitive to the needs of the students since the students pay fees and could easily leave the school if the school is not providing the education they expect. This leads to a higher propensity for change, at a faster rate. Logistically, the smaller school sizes provide a smaller and more manageable ecosystem for study where intimate teacher interactions can be captured from the whole-school perspective. In addition, the financial constraints and the lack of formal pre-service training for teachers (MTI, 2008) make the private school context a relevant and challenging one for research. It is in the light of these considerations that the decision to focus on private schools was made.

3.6.3 Selecting the Private School

There are approximately 890 to 1000 private commercial centers or schools in Singapore of highly varying quality from the government-sanctioned private universities (such as UniSIM) to schools which are no longer allowed to operate (APSC, 2009). Many of these centers offer different types of classes ranging from tuition in academic subjects, non-academic interests to sports for primary, secondary

and post-secondary students. Since this study is about pedagogical excellence through the use of ICT in private commercial schools, focusing on schools offering academic disciplines leading to accreditation or national examinations would provide a more structured and stable approach.

The way forward was to select a private school that has demonstrated some success in developing its students, achieving good academic results, on top of demonstrating innovative practices to ICT implementation despite the typical constraints faced by private commercial schools. The literature stated in Chapter Two highlights the need to search for schools with strong instructional leadership (Staples *et al*., 2005), a positive ICT culture (Bain, 2002) and where technical support is available. The school should also be moving forward with ICT reform since this would provide sufficient evidence of the *process* of ICT implementation and the pitfalls in the process.

While the process is important, the outcomes indicators such as academic results serve as additional criteria on indication on the quality of education in the school. These indicators provide a useful basis for comparison with Singapore government schools. Where possible, the school should be somewhat established with a clear school culture and a stable system, implying relatively low staff turnover and leadership consistency to facilitate the study of the key principles and processes leading to a possible working model for ICT implementation in the school.

3.6.4 The Four Parameters: Setting, Actors, Events & Process

To help structure the conduct of the study, the study will follow the four parameters suggested by Miles and Huberman (1984) and described by Creswell (1994): *setting* (where the study will occur), *actors* (who will be interviewed), *events* (what the interviews, direct observations and documentation would be about), and the *process* (the actions and interactions undertaken by the actors within the setting). Researching a private school implies the need to consider the school schedule such as holidays, examination periods and camps.

3.7 Setting: Cool School Ltd

Cool School[1], established in 2002, has shown some interesting teacher capabilities resulting in relatively good results (96.9% obtaining O Level Certification in 2008) by its graduates for the "high stakes" Ordinary (O) Levels Examinations (set by Cambridge Examination Syndicate) over the past 7 years, consistently scoring above the National Average (94.6% in 2008) in terms of the number of passes for private school candidates. See Figures 3.1 & 3.2 for the statistics as displayed on the school's website.

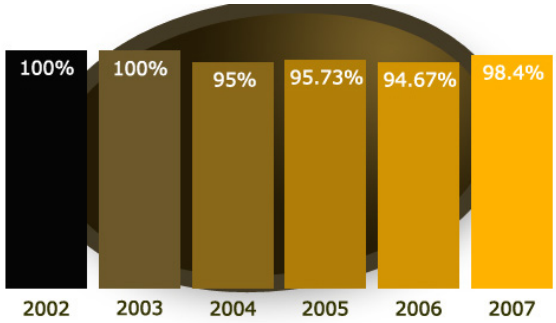


Figure 3.1. Percentage of Cool School Students who Obtained O Levels Certification

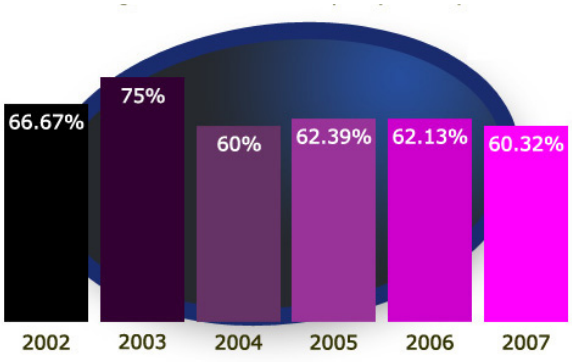


Figure 3.2. Percentage of Cool School Students who qualify for Polytechnics

The percentage of Cool School students qualifying for polytechnics and tertiary institutions is at a respectable 60.32% in 2007. With approximately 8% of the Singapore private candidature taking the O Levels Examinations enrolled in Cool School each year, it wields a significant amount of influence on the private education scene.

Having started out as a free tuition centre run by church volunteers (some of whom became the current teachers) in 1998, Cool School was driven very much by strong underlying Christian values with a purpose of changing lives, one at a time. As a result, the teachers possess tremendous amount of energy and passion to make a difference to the youth. A quotation by one of the Heads of Department (HOD) on the school's website, 'many love to teach … but there are those who teach to love' sums

[1] All names are changed to protect the school and teachers

up the ethos of the school and its mission ‘to develop its students to impact and inspire the world with excellence, ingenuity and servitude’.

Given its mission and ethos, Cool School enrols delinquents and youth at risk. With the majority of its 300 students being school dropouts from public schools, Cool School provides an inspirational approach to working with these students. Numerous awards have been given to the 15 full-time staff (at an average age of 30 years old) for the work they put in to turn the students around. The Principal was awarded the Social Entrepreneur of the Year Award in 2007 (See Figure 3.3.). One of the Physics teachers was awarded the National Youth Award in 2008 for her work with delinquent youths in the school. The ComCare award was given to Cool School by the Prime Minister of Singapore for its efforts in stamping out smoking among the youth. In addition, the school has been featured numerous times in national newspapers for producing top private school candidates.

[Articles deleted]

Figure 3.3. A Selection of Newspaper Articles on Cool School over the Years

To the school’s credit, the Senior Parliamentary Secretary for Education and Home Affairs, Mr Masagos Zulkifli Bin Masagos Mohamad and government school principals have visited the school personally to understand the workings of the school and how it turns delinquents around through innovative teaching.

From the preliminary interviews conducted with the three Cool School teachers, there is some evidence of innovative ICT use such as experimenting with the mobile phone as a mass response feedback tool in class and utilizing SmartBoards (Interactive Whiteboards) to make the teaching more effective. Cool School also encourages ICT innovations with minimal interference from the school leaders (corresponding to the ‘Anarchic Development’ model espoused by Pospisil and Willcoxson, 1998).

Teachers generally innovate out of their own passion to teach better. Underlying these ICT innovations and use is the inherently close student-teacher relationship that is characteristic of the school. The teachers show genuine care and the students know it. However, despite adopting a pro-ICT approach in Cool School, there are still budget constraints and a lack of training opportunities as a private school setup.

3.8 Why choose Cool School as a Case Study?

3.8.1 Consideration of Sampling Errors

According to Silverman (2006), for practical and logistical reasons, the sample, while demonstrating the phenomenon under examination, should be accessible and should provide appropriate data reasonably readily and quickly. The choice of Cool School as the research site was made after careful considerations of the selection criteria highlighted in the literature on strength of school leadership, teacher characteristics and technical support along with pragmatic reasons such as ease of access and data availability.

In spite of the apparent flexibility in purposeful sampling, it is necessary to consider the three common sampling errors in qualitative research. According to Patton (1990), the first relates to data distortions due to insufficient breadth in sampling. The second arises from distortions introduced by changes over time and the third is attributed to distortions caused by the lack of depth in data collection at each site.

The first error is unlikely in this study as the majority of Cool School teachers will be studied. The second and third errors are possible although both can be negated with an iterative approach over a period of time. It may be necessary to remain engaged with the school for a year or more to study the stability of the changes and the effectiveness of certain ICT implementations. However, given the limited resources available and the time constraints imposed to complete this study, a more lengthy study may not be possible.

Cool School provides a relevant sample as a Singapore private commercial school on how it adopts ICT in the classroom despite its financial and logistical constraints. It sources for funding from students and other organisations. Most students range

from 16 to 23 years old and have dropped out from mainstream secondary schools due to disciplinary issues or other circumstances. However, as mentioned earlier, 96.8% of these students eventually graduate with at least one Ordinary Level pass awarded by the Cambridge Examination Syndicate based in the United Kingdom.

With typical constraints faced by private schools (low funds and academically weak students), how does Cool School use ICT in the classroom to reach its objectives? Compared to other schools, Cool School is considered medium-sized with a teaching staff of 15 teachers, inclusive of the principal and vice-principal. Most of the teachers have been teaching for a few years (between 2 to 7 years). Among all the teachers, only two teachers have undergone formal pre-service teacher training at National Institute of Education (NIE). The lack of formal teacher training background and its impact on ICT implementation would provide data for discussion on how important pre-service teacher training is to private schools.

The school is equipped with wireless network which implies that students can utilise laptops and mobile phones to download materials from relevant websites or follow the teacher's lesson online. There are alternative assessment methods through interactive media such as FaceBook, Twitter and YouTube websites. Lastly, blogs are set up for students to access and communicate with teachers and other students e.g. seniors and teachers for help. These ICT tools have been set up in the recent months and are still in the infancy stages of use. Hence, it will be useful to examine how the school manages the growth of these ICT initiatives by teachers.

3.8.2 Further Justification for Single Atypical-Case Study Approach

However, Cool School is also an atypical private school. One of the reasons is that it welcomes school dropouts from public (government) secondary schools. There are more than 24 newspaper articles over a span of 7 years reporting on its success stories and awards. It is also the only one of two private schools awarded examination venue status (for O Levels) by the Singapore Examination and Assessment Branch. In addition, Cool School obtained the CaseTrust for Education certification in 2007 and the EduTrust Certification Mark (www.cpe.gov.sg) in 2010.

This certification mark is necessary for private schools to enrol foreign students. To date, only 53 private schools in Singapore are awarded this certification mark. Cool School prides itself on being a forward-looking school that is keen to engage students at their level, according to their interests.

3.9 Researcher Positioning

My involvement with Cool School goes back to 2007 when I volunteered to be part of the Board of Directors, assisting in the yearly audit checks and other Directorship duties. Since then, I have stepped down from the board, having served for 2 years. Hence, the study began about 4 months before my resignation from the board and ended about 8 months after. Interviews continued throughout this period as my relationship with the school is relatively strong and the teachers know me by my first name. When I was on the board, I had no executive power and I did not decide on promotions or teacher matters. The teachers were also aware of my honorary role on the board. I also rented a room in the school for my work purposes for 1.5 years beginning in 2007 but moved on to another place before the start of the study. As such, I have some experience with the culture of the school.

My initial apprehensions of using Cool School for this study stemmed from the concern that teachers would provide biased data. However, given the extent of my experience with the school and my knowledge of how ICT is used in class, I would be able to probe further if teachers are indeed providing 'favourable' accounts. To reduce potential bias either by the teachers or myself, additional checks such as member checking procedures and cross-checking issues with school leaders and other staff and documentation (such as from blogs and forums) will be carried out. Reports of ICT initiatives (e.g. recording video clips of Science experiments) were confirmed with several teachers in and outside of the department.

Despite the apprehensions, there are advantages to using Cool School as a case study since I am privy to information at the school management level and so would be able to understand the processes and culture involved. At the same time, I am not a paid staff nor do I report to the school management so the results from the study would not have any bearing on my role in the school as a volunteer. The cordial and

professional relationship with the staff would provide a good starting platform for discussions and interviews. The teachers and leaders know me sufficiently over the past 3 years to be a person who can maintain confidentiality.

While my involvement in the school may cast some doubts on the relative 'objectivity' of the data collected, I would also present some strengths as a result of this relationship, what Strauss and Corbin (1990) refer to as the 'theoretical sensitivity' of the researcher.

> *Theoretical sensitivity refers to a personal quality of the researcher. It indicates an awareness of the subtleties of meaning of data. ... 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.*
>
> Strauss and Corbin (1990, p. 42)

They believe that theoretical sensitivity comes from a number of sources, including professional literature, professional experiences, and personal experiences. The experiences I have with the management and the teachers provided a useful platform to build on those relationships during the interviews and school visits. In hindsight, it was probably easier for me to relate and empathise with the teachers and management than an outsider due to the trust developed over the years.

Expectedly, the issues are complex and require in-depth investigation and analyses. Skilful unravelling of the complex organizational workflows and careful mapping of the way different entities in Cool School interact with each other were the challenges faced in this research study.

3.10 Actors

In selecting teachers for the study, Yin (2009) advocates screening of case study candidates before deciding on the final array of case study units (teachers) from among the candidates. This is to reduce potential non-viability of the 'case units' and the resultant waste of resources to collect the data. More importantly, the selection of the candidates should be based on a set of operational criteria 'to yield the best data' for the study.

Due to the small size of the school (about 15 teaching staff at the point when the study started), this implies that pre-study screening to select the case units may not be necessary since all the teachers will be invited to participate in the study. The study will be of the entire case (whole school of 15 teachers) rather than to take a sample of the teachers. However, pre-screening was still conducted to determine if all the case units are suitable to participate in the study.

The operational criteria for the pre-screening process include:

- Teachers who have been with Cool School for at least a year
- Teachers who are employed on a permanent basis
- Teachers who are teaching a whole class and not part of the class

These criteria are to exclude relief teachers who are only at Cool School for a few months on a project basis and staff who are teacher aides and do not teach. The operational criteria were given as such to reduce the likelihood of staff who have not yet imbibed Cool School culture from contributing to the evidence pool on the premise that their views may be contrarian to the Cool School teachers' perceptions and way of doing things. Given these criteria, there are two teachers who fall into this category of part-time teachers for less than a year. They do not have their own desk in the school and only teach in the evenings due to their full-time job elsewhere. These two teachers are excluded from the sample of 15 full-time teachers.

In what is rather unique to the school, the turnover rate of teachers in the school is low. Fewer than 5 teachers have left the school over the span of 7 years with many of the pioneering teachers staying on for more than 6 years. All the teachers are less than 40 years old with the majority in their early 30s. The principal himself is only 35 years old. The profile of the teaching staff is shown in Table 3.2 below.

	School Leaders (VP, P)		Managerial Roles (HODs,)		Teachers		Total
	Male	Female	Male	Female	Male	Female	
With Formal Teacher Training	0	0	0	0	0	2	2
Without Formal Teacher Training	2	0	1	3	1	6	13
Total	2	0	1	3	1	8	15

Table 3.2. Profile of the 15 Teaching Staff in Cool School

However, one teacher did not respond to the invitation to participate in the study despite three requests via emails and personal notes left on her table. Hence, the number of teachers involved in the study is 14. In addition, 2 non-teaching staff were also interviewed as they play a role in assisting in setting up or trouble-shooting any technical issues in ICT. They are the technical officer and facility officer.

3.11 Events

Yin (2009) lists 6 sources of evidence as the most commonly used in doing case studies: documentation, archival records, interviews, direct observations, participant-observation, and physical artifacts. Yin (2009:p.101) is also careful to add that 'no single source has a complete advantage over all the others… the various sources are highly complementary…' To ensure the evidence collected in this study is valid and authentic, three sources would be used: interviews, direct observation and documentation.

3.11.1 Interviews

3.11.1.1 Formulating the Interview Questions

> *"… a strength of qualitative interviewing is the opportunity it provides to collect and rigorously examine narrative accounts of social worlds."*
>
> Miller & Glassner (2009:p.137)

While the interview is a research methodology, it is also a social interaction which must be "nurtured, sustained and then ended gracefully" (Seidman, 1998:p.79). It is important to follow certain protocols of courtesy and confidentiality when conducting effective interviews. The trust built between the interviewer and the respondent will lead to more meaningful questions and in-depth and truthful answers (Merriam, 2009). Similar views were expressed by Kvale (2006) on how interviews can be a one-way dialogue with the interviewer holding the monopoly of interpretation.

Researchers should be aware of the power they hold and how to induct their participants into the interview so that the process is more comfortable and natural for these participants.

Besides being cognisant of the interaction process, the content and depth of the interview is also important. Yin (2009) lists 3 types of interviews: in-depth, focused and survey interviews. The first deals primarily with key respondents who are willing to share important pieces of information. The 'interview' may take place over several sessions rather than a single sitting and these informants rather than respondents are often critical to the success of the case study although Yin (2009) cautions against over-reliance on a single source of evidence and to triangulate the evidence from these informants with evidence from other sources or documentary evidence. There were several teachers whom I could interview more often and for longer periods of time and eventually, they became my critical informants whom I could validate information with or corroborate insights that I received from others. The focused interview, on the other hand, is carried out over a shorter period of time – an hour, for example and 'assumes a conversational manner' (Yin, 2009). This type of interview was also the key mode of evidence gathering for this study due to the tight schedule most of the teachers had. A probing style of questioning based on a list of questions or what Merriam (2009) termed as the 'interview schedule' was used to elicit responses in a semi-structured manner (see Appendix 2). A third form of interview - survey interview – entails more structured questions, along the lines of a formal survey was also used in this study (see Appendix 3). This is to obtain a measure of teacher competence and allows for simple comparisons among the teachers. Initially, out of the 14 teachers, there were 2 teachers who declined to be interviewed but were agreeable to completing the interview schedule and emailing their responses back to me. Follow-up to their responses was conducted via emails although in a limited fashion as these teachers were relatively busy and did not respond in an extensive manner compared to the other teachers.

There are several approaches which can be adopted to conduct the interview: survey interviews, creative interviews and active interviews. In survey interviews, the interviewer is to maintain an objective, non-judgemental approach when working with the interviewee. The interviewer has to 'suppress personal opinion, and avoid

stereotyping the respondent' (Holstein & Gubrium, 2009:p.146) during the interview process. In contrast, the creative interview, aims to delve beyond the 'surface of experience' into the respondents' 'emotional wellsprings' through mutual disclosures. It is not uncommon for the interviewer to share his or her feelings and deepest thoughts to assure respondents can also share their intimate thoughts during creative interviews (Douglas, 1985). According to Douglas (1985), creative interviewing shares the same traditional model of the respondent as a vessel of answers as survey interviewing and this is perceived as contrived and unnecessary. The third approach, active interviewing, acknowledges and appreciates the participation of the interviewer in shifting positions during the interview so as to explore alternative perspectives and beliefs. This approach contrasts greatly from the survey interview and creative interview approaches in that it views the interviewer and the respondent as collaboratively 'involved in meaning construction not contamination' (Holstein & Gubrium, 2009:p.155) and interview 'bias' can be used to generate useful data for analyses. However, Holstein & Gubrium caution that active interview data require careful analyses, with considerations of the meaning-making process and the contexts of the speech.

In this study, the active interviewing approach constitutes shaping the interview into an interaction where the teachers and I would make meaning of their responses together. The rationale is that I am familiar with the school culture and some of the teachers know me well. According to Miller & Glassner (2009:p.131),

> *Some scholars have argued that researchers should be members of the groups they study, in order to have the subjective knowledge necessary to truly understand their life experiences.*

Besides, to adopt a survey interview approach may seem cold and apathetic. Similarly, the creative interview may put the teachers and me in a dilemma especially if by drawing on the 'wellsprings of emotion', the teacher turns overly emotional and expects me as a former Director to solve the issue for them which is not the context or the purpose for the interview. However, there are issues of trustworthiness arising from the active interviewing approach such as ensuring the responses are truly from the respondents and not a derivation of the interviewer's

role and comments in the interview. Furthermore, the issue of the interviewer skewing the responses to what is perceived as desired is a real one and requires addressing in the subsequent section on establishing trustworthiness.

3.11.1.2 Administration of the Interview

On the day of the interview, the teachers were again asked for their consent to be interviewed and that they did not have to say anything that they are not comfortable with. They were reminded that they had the right not to answer any of the questions posed. Confidentiality issues (Patton, 2002) were addressed including the use of pseudonyms in the final report and I briefed them on the objectives of the study before commencing. These pseudonyms were carefully chosen to 'reflect the issues of ethnicity, age and the context of the participant's life' (Seidman, 1998:p.104).

Permission was also obtained from the teachers to audio record their responses. There are some concerns on the use of an audio recorder, for example Lincoln and Guba "do not recommend recording except for unusual reasons" (1985, p. 241). Their rationale stems from the fact that electronic recorders may cause the subject to withhold key information during the interview and logistically, there is always the possibility of technical failure. On the other hand, Patton says that a voice recorder is "indispensable" (1990, p. 348). One key advantage is the opportunity to engage the respondent during the interview and provide good eye contact to encourage the respondent to go on. In addition, the voice recorder could be replayed to check for accuracy of the transcript.

A sound check on the quality of the recording was made before the interview formally began. The audio recorder is usually placed to the side of the table or under a piece of paper especially if the teacher showed signs of being distracted by it.

A quiet room or a closed school café were used for the interview. There were no teachers or students in the proximity to disrupt the interview process although teachers did receive one or two 'urgent' phone calls which they quickly answered and returned to the interview process.

During the interview, non-verbal cues to encourage and acknowledge the teacher's responses were used, for example *'nodding'* and promptings such as *'yes'* and *'what else'*. An amiable and conducive atmosphere was built at the beginning of the interview with simple and non-sensitive questions about their background. Teachers were generally relaxed and smiled at regular points in the interview. Some jokes were exchanged to encourage more openness and trust, which is a part of the active interviewing strategy (Yin, 2009). It is important to note here that since the interviewer is an insider researcher, it is naive to assume that there is no prior knowledge on the part of the researcher. Rather than work from the perspective of no prior knowledge, it may be more constructive to work from the perspective of the researcher possessing shared knowledge with the teachers and interview based on that shared knowledge. Hence, the interviewer may start a new strand of discussion concerning the Interactive Whiteboard (IWB) and how some teachers do not seem to like use it. The interviewee is allowed to respond in the negative if he or she disagrees. The opinions expressed by the interviewer are usually phrased as questions rather than statements so that the interviewee can critically analyse the issues or counter the key points in the questions. Such an approach will mitigate any possible effects of the researcher influencing the teachers' responses through active interviewing.

Generally, transcripts were made verbatim based on the audio recording. There were some 'uhs', 'ers', 'hmms' and other 'fillers' in oral speech which were edited and removed during the transcript writing process to present 'write ups which can be read or edited for accuracy' (Miles et al., 1994:p.51).

The transcripts were emailed back to the teachers for their verification and amendment if necessary. The few amendments made by the teachers were more editorial in nature e.g. punctuation or spelling errors. There were no changes to the content of recorded in the transcript.

3.11.2 Piloting the Interview Instruments

3.11.2.1 Stage 1: Development and First Piloting Exercise of Instruments

The first piloting exercise of the interview and survey instruments was carried out with two teachers and an ICT technical support personnel from a government school. These teachers had more than 5 years of teaching experience and had used ICT numerous times in their course of their work. One was an ICT HOD (Head of Department) while the other was a Level Representative responsible for ensuring the 10 teachers in her level grouping (primary 3 teachers) utilized ICT tools to teach on a regular basis. Both were qualified teachers teaching in different schools.

The interviews took approximate 30 minutes for the ICT HOD and 70 minutes for the Level Representative. The technical support aide was interviewed for about 20 minutes. The focus of these pilot interviews was to check if the questions were comprehensible and relevant to teachers. Brief notes (see Figure 3.4.) were taken for the interviews.

School Culture	
22. What kinds of support do you get from a) colleagues b) superiors (e.g. IT HOD) c) technical staff?	HOD is away for 6 months; quarterly newsletter provided to showcase the websites for possible use in class; share portal by MOE – forced to contribute
23. What kinds of support are you looking for from a) colleagues b) superiors (e.g. IT HOD) c) technical staff?	Suggested specialized teaching i.e. focusing on teaching specialized subjects
Attitudes & Temperaments	
24. How do you feel about the use of ICT in teaching? Any advantages or disadvantages?	One teacher did not bring her class to the computer lab for the whole year – doesn't care attitude but she has to answer for it; Level Head has to convince her that the students would benefit from the lesson. Some older teachers cannot cope with ICT – feel relieved when click on 'Print'. Perhaps the infrastructure can be improved e.g. repair the computers/ TAs keep changing because of low salary; iBooks are white elephants because only used for PODCast/VODCast; cannot read WORD Docs. Need to engage children; no point going through ICT for the sake of it. Teachers are forced to write lesson plans e.g. Webshare
25. Compared to traditional teaching methods such as using chalk and board, how do you think ICT benefits the learning process?	Visual with animation benefits learning of certain subjects e.g. Maths and Science but some teachers feel that manipulatives are good enough

Figure 3.4. Example of Brief Notes taken During the First Pilot Study with Level Representative

3.11.2.2 Modifications to Interview Questions for Main Study

Subsequently, the following changes were made to the interview checklist:

1. The questions appear to be relatively surface-level, asking questions which lead to 'Yes/No' answers rather than probing questions to elicit reasons and processes. The questions were modified as a result to tap on processes and reasons.

e.g. "Do you have any history behind your ICT use?" was changed to "How did these bad experiences affect your usage of ICT now?"

2. Additional questions probing the level of technical support provided were inserted.
e.g. "Do you have an ICT mentor to help you plan and carry out lessons using ICT?"

3. There was a need to probe deeper concerning the attitudes of private school teachers towards ICT use in the classroom. It was discovered during the initial interview sessions with the teachers that the school management actually gave teachers the autonomy in deciding whether or not to use ICT for teaching.
e.g. "Do you see the ICT initiative as similar to other changes implemented by schools? Do you respond to them in the same way?"

3.11.2.3 Personal Reflections on Interview Checklist

I realised that many questions were 'fluid' and depended on the teachers' responses to them. Hence, some improvisation was needed during the interview. In addition, writing down answers while engaging the interviewee is not easy and requires skill and expertise. Hence, voice recording was put in place for the subsequent interviews. It is important to know the interview instrument well enough to not repeat questions that have been covered. I also took time to explore how to factor in the different levels of student engagement using ICT during lessons.

3.11.2.4 Interviewing Teachers from Cool School

Subsequently, with the change from a government to a private commercial school, I modified the interview questions to ensure relevance. The interviews with the first three teachers from Cool School provided good inputs on the likely findings to be generated. As a result, questions specific to ICT usage in Cool School were added.

For example,

Comparing private and government schools, do you see any difference between the two in terms of how ICT is used? Do you see your private school as being more advanced in terms of ICT usage compared to other private schools?

Following the transcribing of the interviews and coding exercise, one finding that emerged from the data was the presence of 'self-help groups' among the teachers. These groups provided their own technical support and shared best practices. To investigate the processes behind these 'self-help groups', a second list of questions was drawn up to determine the frequency and nature of exchanges among the teachers as well as the types of ICT projects the teachers were involved in. This further investigation constituted the second phase of the study.

3.11.2.5 Refinements to Research Questions

The research questions were modified to include the ICT support provided by the technical staff and school leaders besides teachers.

As a result, the initial Main Research Question was modified from:

"What is the degree and character of ICT-led pedagogy in Singapore private schools and the challenges these private school teachers face and how are they coping with them?"

to:

"How have teachers, school leaders and technical support staff in a Singapore private school (Cool School) managed the implementation of ICT in the curriculum across the school?"

The focus in the new primary research question is on Collegiality (ICT support within the school context) rather than the frequency of ICT implementation. The new research question takes into account the complex interactional patterns which occur within the school and this has implications on the type of ICT model which can be adapted for effective use in private commercial schools such as Cool School. The

specific research questions are then aligned accordingly to the main research question with the focus on teacher perceptions and ICT support-related issues to reflect the high resource constraints in private schools.

3.11.3 Documentation

Teacher-produced documents which include ICT-based assignments given through web-based blogs and websites are useful for researchers to examine as supplementary evidence in support of the data collected from interviews. In addition, these web-based assignments are dated and provide snapshots on the evolutionary process of how ICT is used to engage the students in different ways over time.

In the case of Cool School, the documents refer specifically to web documents in everyday action such as blogs, web pages and video clips used by the teachers for teaching. In analysing the contents of the documents, Merriam (2009:p.157) clarifies that “web pages, papers available through file transfer protocol, and various forms of ‘electronic paper’ can be considered documents that are simply accessed online.”

3.11.4 Direct Observation

Triangulation of the interview data with classroom observations would have been ideal. Whether teachers actually carry out their claims made during the interviews can be confirmed through classroom observations. However, there are issues with observations. Firstly, the lesson could have been staged for the observation so what is observed may not be the norm. Secondly, it does not imply that the unobserved activities are not carried out in other lessons. To ensure the lesson observations are authentic and representative of what teachers are capable of doing in the classroom with ICT, follow up interviews and discussions will have to be conducted. This presents a number of problems. Notably, the amount of data collected will increase exponentially, possibly to an extent that is outside the scope of a doctoral study. In addition, the use of interviews to clarify or confirm what was observed suggests that the study will still have to rely on interview data as the primary source of evidence. If so, the value of the data from lesson observations to the study may be questionable.

Having said that, pictorial evidence of the environment scans (e.g. computers in Cool School library) does supplement the interview data and is included in the study.

3.12 Administering the Study

Securing the consent of the management of Cool School for the pilot and final study took a relatively short period of time (less than a week) but obtaining the consent of the teachers took a slightly longer time, up to a month for some teachers. An email stating the purpose and duration of the research was sent to all the teachers. See Appendix 1. Further assurance had to be given to the teachers before they would agree to the pilot interviews. However, as Asians are generally shy and more reserved, the teachers sometimes do not describe the full extent of occurrences to protect themselves and their superior.

The interview sessions were conducted smoothly although getting teachers to find time for the interviews was difficult at times. Some of the teachers were careful to explain their responses in great detail to ensure that no misunderstanding takes place especially with the interview being recorded for transcribing later. This also points to the need for interviewers to build rapport with their interviewees.

See Table **3.3.** below for breakdown of the figures.

	Number of Staff	
Teachers interviewed face-to-face	10	
Teachers responded through written responses	4	15 Teachers in total
Teachers who did not participate in interview	*1*	
Facility and Technical Officers interviewed	2	
Total number of Staff Interviewed	16	

Table 3.3. Number of Subjects in Study

With regards to the support staff involved in the study, both the technical and facility officers are males and have a Diploma in Biochemistry and an O-Levels certificate respectively. Their job roles do not actually concern ICT but general equipment and facility management in the school. However, the technical officer and facility officer are relatively competent in ICT and provide support where possible. They are the

ICT support team in the school by default. All 16 respondents are 36 years and younger. A summary of the staff's personal attributes are listed in Table 3.4 below.

	Code	Role in School	Gender	Marital Status	Academic Qualifications	Formal Teaching Qualifications
		Humanities (H)				
1	P	Principal, Economics	M	Married	B. Business, M.Education	Nil
2	VP	Vice-Principal, Mathematics	M	Married	B. Eng, Undertaking M.Ed	Nil
3	H2	HOD, Humanities	F	Married	B. Arts M. Public Administration	Nil
4	H3	Teacher, Geography	F	Married	B. Computer	Nil
		Languages (L)				
5	L1	Teacher, English	F	Married	B.Arts	Nil
6	L2	HOD, English	F	Single	B.Arts	Nil
7	L3	Teacher, English	F	Single	B.Arts (Hons) Pursuing Masters in English (Distance)	PGDE (Postgraduate Diploma in Education)
		Mathematics (M)				
8	M2	HOD, Mathematics	F	Single	B.Sc (Hons) Pursuing MSc (Mathematics)	Nil
9	M3	Teacher, Mathematics	F	Single	B. Math	Nil
		Science				
10	S1	Physics Teacher	F	Single	B. Eng	Nil
11	S2	HOD, Science	M	Single	B. Eng (Hons)	Nil
12	S3	Teacher, Chemistry	F	Single	B. Eng	Nil

		Adviseor			M.Soc (Adviseing)	
13	S4	Teacher, Chemistry & Biology	M	Single	B. Sc	Nil
14	S5	Chemistry Teacher	F	Married	B.Eng	Nil
		Support Staff				
15	T1	Technical Manager	M	Single	Dip. BioTech	NA
16	T2	Facilities Officer	M	Single	O Levels	NA

Table 3.4. Background Characteristics of Teachers and Technical Staff in Study

The teachers are assigned codes (e.g. S2) in place of their real names. The codes provide information to the subject they teach (S – Science, M – Mathematics, H – Humanities, L – Languages).

The school tried enrolling their other non-NIE trained teachers for the Post-Graduate Diploma in Education programme in NIE but their request was turned down. Even though most teachers do not have formal teacher qualifications, four (including the Principal and Vice-Principal) have a Masters Degree in Education or Public Administration or are enrolled in a Masters Programme currently.

The positions in Cool School include Head of Department, Advisor and Teacher. The range of subjects taught at Cool School aim at helping the students meet the/ entry requirements of polytechnics in Singapore with a good mixture of humanities (Geography, History, Economics and Social Studies), Sciences (Chemistry, Physics and Biology), Mathematics and the Languages (English and Chinese Language).

3.13 Schedule

The data collected are conducted through interviews at different phases of ICT implementation to allow longitudinal mapping of ICT developments. See Table 3.5.

Phase	Activity	Remarks	Approximate Duration

1	Interview staff on perceptions of ICT implementations in the classroom	Interviews lasted 1 to 1.5 hours Open-ended questions in paper surveys were used for teachers who were not available for interviews	6 months
2	Interview teachers on their interactional or collaboration patterns with each other and the support provided by the management	Interviews were shorter and more focused on interactional patterns Paper surveys with open-ended questions were used for teachers not available for interview	1 month
3	Presentation of study findings Member checking of results Follow-up discussion on ICT initiatives and development mentioned by teachers in phases 1 and 2	Mass feedback and discussion Interviews with specific teachers	1 month

Table 3.5. Timeframe for Development of Study

In particular, phase 2 of the study took a slight turn to examine interactional patterns among groups of teachers when data from several teachers point to a tendency among teachers to work on an ICT project within their cliques. The refocus of the study on examining the composition of these cliques is part of the iterative process in qualitative studies, to delve into reasons and rationale for certain observations uncovered during the interviews.

Besides the third phase of data collection which will allow teachers to check the data presented in the study, the individual teachers were also emailed the transcription of the interview conducted with them. This is important given that perspectives and attitudes do not occur in a vacuum of values or people, the need to triangulate the data collected with other teachers and leaders will be crucial (Yin, 2003).

All of the data collection was carried out in the school itself for convenience to the teachers and to help them contextualize the responses they give during the interviews. The schedule used to plan the research study is shown in Table 3.6.

	Research Activity	Timeline
1	Piloting of questions through interviews with teachers Refining of research questions	Feb – July 09
2	First round of interviews with teachers on their perceptions, difficulties and challenges faced in implementing ICT	July – Sep 09
3	First round of Interviews with school leaders on their perceptions of ICT use, ICT policy and ICT infrastructure in school	July – Sep 09
4	First round of interviews with technical staff on their perceptions of ICT infrastructure	Sep 09
5	On-site observation of ICT equipment in the school environment	Aug 09
6	Non-intrusive online observations of the blogs and forums used by teachers when working with students	Jul 09 – Feb 10
7	Transcribing the interviews into text for member-checking	Jul – Sep 09
8	Second round of interviews and surveys Email correspondence to probe practices and interactional patterns uncovered during the first interview	Sep 09 – Dec 09
9	Generic and axial coding of data	Aug – Dec 09
10	Generation of theory from data	Jan – June 10
11	Third round of discussion with teachers and ICT teacher leaders	Aug 10
12	Final drafting of report	Aug – Dec 10

Table 3.6. Detailed Schedule of Research Study

3.14 Data Analyses

There were two sources of data which had to be analysed. The first involved data from the interviews with the teachers. This included written responses from teachers who were not available for the interviews. The second source of data came from documents such as web pages and school assignments posted online. As these

webpages were active, a sampling of the changes and additions to these documents were conducted at three to six-monthly intervals..

3.14.1 Interview Data

The process of data analyses for data obtained through the initial round and subsequent follow-up interviews was carried out in four stages: Firstly, the responses from the initial interviews with Cool School teachers were analysed to form general categories. These categories provided the structure for the remaining interviews with the rest of the teachers. The second stage involved analysing the voluminous data from the interviews with the remaining teachers, support staff and school leaders. In the third stage, the number of categories is reduced to make sense of the data. Finally, in stage four, additional data from the teachers' interactional patterns were mapped out in the form of a socio-gram.

3.14.1.1 First Stage: Generating Categories from Initial Interviews

To analyse the data, codes were generated based on the transcript for each of the three initial interviews, employing qualitative analysis which involved reducing data through coding and thematic techniques outlined by Silverman (2006). The coding process involved categorizing each answer provided by the teachers firstly with very specific names or codes (for example, "Age of Teachers"), determining the number of categories and then grouping them together with other sub-categories (for example, "Gender") to form a major category (for example, "Demographics data"). The purpose of generating broader categories is to allow possible patterns of behaviour or thinking to emerge from the data. This 'emergence' of patterns could be based on the evidence alone or from another hypothesis or theory (Merriam, 2009).

During the taped semi-structured interview, brief notes were taken to highlight any particular interesting data and to check if there were questions not asked. Following each interview, the recording was downloaded into a computer and the audio proceedings were transcribed as described earlier, into a Microsoft WORD Document. Upon completion, the transcript (see Figure 3.5.) was emailed to the teacher directly for member checking and augmentation.

Questions	Responses	Concepts
Demographics		
1. May I ask for your age? Gender?	31 this year. Female	**Demo-Gen-F** **Demo-Age-31**
2. How many years have you taught? At which level?	Third year, now going to fourth. Previously was always private tuition, not in an institution.	**Hist-Sch-None** **Hist-CHEC-4**
3. May I ask if you have any children of your own? Married?		**Demo-Mari-S**
4. What are some of the schools you taught in? Were they boys, girls or mixed gender schools?		**Hist-Sch-None**

Figure 3.5. Example of Transcript Emailed to Teacher for Checking

3.14.1.2 Second Stage: Increasing the Number of Categories

To code a specific piece of data, I reviewed the information found in the sentence or passage and determine the nature of the information. A code was added to a column on the right of the data. If there is no code already generated in the code bank, a new code will be generated. This coding system (Lichtman, 2006) is hierarchical in nature. For example, 'demo-gen-F' is the code for subject's response shown above, with the first term being the broad category (e.g. 'demo' which stands for 'demographics'), followed by sub-categories (e.g. 'gen' for 'gender') and then the datum itself (e.g. 'F' for 'Female'). I keep the code system active with the generation of new codes with each new transcript and the merging or elimination of old codes if found unsuitable. Where possible, the original statements are used as part of the codes (Charmaz, 2006).

Questions	Responses	Concepts
Demographics		
1. May I ask for your age? Gender?	29. Hmm yes. Hmm, Haha good and bad la.	Demo-Age-29
2. How many years have you taught? At which level?		
3. May I ask if you have any children of your own? Married?	No.	Demo-Mari-S
4. What are some of the schools you taught in? Were they boys, girls or mixed gender schools?		
5. Were you trained in NIE? When was that? Was there any IT course during your NIE days?	No.	Hist-Trg-None Hist-IT Trg-NUS-IT Degree Skil-Advance

Figure 3.6. Hierarchical Coding Used in Transcript

This hierarchical coding system proved advantageous in allowing different permutations of descriptors across different categories which simplifies the code generation process. Fewer codes are needed, for example, ‘Supp-Share’ means the teacher support is made available through the sharing of ICT resources. Similarly, ‘Pol-Share’ means the ICT policy in school is to encourage teachers to share resources. With this root word system as part of the ‘mix-and-match’ coding syntax, codes are less cumbersome, more comprehensible and allow for flexibility. Eventually, a matrix of codes was formulated which showed the broader categories and their sub-categories (see Figure3.7).

32. Teacher's Perceptions about ICT Policy	**ICT Policy (Pol)**	Set by Principal (Prin)	Flexible (Flex)	High Expectations (Exp-High)	Low Expectations (Exp-Low)	Cutting Edge (Cut)	Lead by example (Lead)	Checking effectiveness of lessons through … (effect)
		Students' attendance (attd) Students' Feedback (stud's fdbk)	Set benchmark for teachers (Benchmk)	Set minimum standards for teachers to follow (min)	Minimum standard is PPT (min PPT)	Share resources with everybody e.g. email links to all (share)	Allow teachers to use ICT according to their style and strength (tr style)	Helping within the department or by subject (within subj)
		Train the teachers first (train)	Motivate teachers to use ICT through resources e.g. all teachers given a laptop (Mot-resources)	ICT Customised to School's Needs e.g. Admininstrative software (Cus)	Principal asked staff to review software (Prin-Review software)	Trs not expected to carry out ICT for a fixed number of lessons (Expect-No Number ICT Lessons)	Use ICT when it is hard to teach, imagine,	Use ICT as frequently as possible (freq)
		ICT is another tool for teachers to use (ICT another tool)	Start with simple or cheap ICT (Start-Simple)	Use available ICT (Avail ICT)	See ICT being implemented in other classes and be inspired (See It)	Sit in on each other's lessons to learn (Sit in)	All teachers take responsibility for ICT lessons rather than just ICT dept (All take Resp)	All teachers mentor each other (All Mentors)
		Use existing Hardware so that students are familiar	School is open to new things / ideas (Open to New	ICT is a tool to help students' future (stud's fut)	Trs need to engage the students through	Trs need to play an active role instead of a passive role	Every teacher will put work online, so	Ensure that hardware is available in school e.g.

Figure 3.7. Example of the 'Mix-and-Match' Coding Syntax

These codes also form the phase of code generation and categorisation. The challenge is to consolidate and streamline categories in phase 3 where data reduction is necessary to make sense of the voluminous data collected.

3.14.1.3 Third Stage: Streamlining Categories to form Analysable Structures

In the third stage, the initial codes were reviewed and a list of emerging themes was drawn up through the merging of similar themes. To prevent researcher bias, the data reduction process was also guided by constant references to the literature and checks with the school staff to ensure the data remain true to the original meaning. See Figures 3.8 & 3.9 for notes on the notes made to identify the emerging themes.

2b. Teacher's Perception of ICT	**Benefits of IT Use for Students (BStud)**	Time saved by teacher in the classroom (Time)	Efficiency (Effi)	Revision & Repetition purposes (Revi)	Engagement (Enga)	Colours engage them (Color)	Sharing of Info (Share)	Relev ance of syllabus (Relev)
		Quality of Teaching Improves (QTeac)	Better understanding of how concepts work (Underst)	Tactile learning (Tact)	Can carry lessons around e.g. iPods or Podcast (Mobi)	Experiential in nature so students are more prepared (Exp)	Stimulates creativity (Creat)	Effective (Effect)
		Exposure to the world (Wor)	Students have choice as to what they prefer to learn (Choi)	Confidence building for students (Conf)	Novelty (Nove)	Saves paper needed for confirmation of Trg sessions (Paper)	Students enjoying the course (enjoy)	Forces students to use and learn ICT (Force)
		Quiet students have a chance to 'talk' or share ideas (QTalk)	Students will remember more (Remb)	Students are captivated (Capt)	Concepts can be learned at their own pace (Pace)	Students can do their own research or check for ans (Rese)	Repetitive playing of video or software poss (Rep)	
	Disadvantages of IT Use for Students (DStud)	- not suitable for Sec Sch students because not relevant (Irrelev)	Lack human touch (Hum)	Skill-based exercises e.g. Science Practicals and English Oral Skills cannot be trained through ICT (Skill)	Students may be bored when they move to another institution when they do not have such IT-enabled lessons (Bore)	Students may not have computers at home (Nocomp)	Students are distracted by the activity rather than focus on the topic (Distr)	Info overload for students (Over)
		Paper examinations while ICT is digital so	Students need to write instead of type during	Students need to be clear and methodological during exams	Students not willing to try or are fearful of the			

Figure 3.8. Teachers' Perceptions of Advantages and Disadvantages of ICT

		practicals (Prac)	students (Scol)	tests (Test)	needed (Hard)	(Techg)	resources from web etc (Selec)	tech and forget to teach (Orel)
14. ICT Support	**ICT Support from Colleagues (Supp)**	Network Problem (Netw)	Technical support (Jeremy) – Jere	Need to be independent (Indep)	Resource-sharing (Shar)	Training from peers (Trg)	Support from Principal (Prin)	Freedom to try (Free)
		Cross-department help and work (XDept)	Fellow Trs / Partners (QTrs)	No expectations from Mgt to carry out a number of ICT lessons per term (Noexp)	Students who can help e.g. IT monitor (Stud)	Shared folder (FShar)	Software and self-help tools (Self)	Technical Assistant (Tech)
	Support needed in ICT (SuppN) - Infrastructure	Videos / animation e.g. cutting clips (Vid)	SmartBoard (SBoar)	Mentor Needed (Ment-Yes)	Mentor not needed (Ment-No)	Trg on PPT or SmartBoard (Trg-Sboar)	Resources sufficient; no need for a lot more (Resour)	Software training (Soft)
		Knowledge in cutting tech (Know)	General teaching training (Ped)	Netbooks for students (Net)			Resources insufficient; need for more (INResour)	
	Provides other colleagues with ICT support (Prov)	Technical issues e.g. printing (Tech)	Frequency of Help – Hi (every 1 – 2 days) Med(every 3 – 7 days) Low (> 1 week)	Shares Resources (Reso)	Sharing of video clips (Vid)	Teaching teachers to create pictures and use applic (Teach)		
1b. Tr's ICT	**IT Skill Level**	Use in daily	Use in daily	(Bas)	(Interm)	(Adv)	(Prof)	Smart Board

Figure 3.9. Teachers' Perceptions of ICT Support in School

These initial themes were then analysed and aligned with the theoretical framework of the study to ensure the data collected remain on firm theoretical grounding (see Figures 3.10 & 3.11).

5a. Teacher's Perception of the basis of ICT use in Teaching	**When ICT should be used (Def)**	Must give a better result and effect (BEff)	Value add to teaching (Vadd)					
5b Teacher's Perception of link between ICT and	**Pedagogy Ped**	Student-centered (Stud) / Engaging	Tr-centered (Tr) / Presenting information	Balanced between students and teachers (Bal)	Teaching methods addressing pedagogy	Mirror the use of tech in the world – a contest		
Teaching (Pedagogy)		students through interactions (Enga)	(Pres) / Creativity in delivering lessons (Creat)		are more important than tech gadgets (Gadg)	of influence (Wor)		
5c. Tr's Perceived Ease of ICT Use by Self	**Current Daily Usage outside of Classroom (Curr)**	IT Usage (Use) -daily / freq (every 2 – 6 days) / weekly / little (> weekly)	Roles in School (Role)	WORD processing (Word)	Excel (Exc)	Internet (Int)	Emails (Ema)	
5d. Tr's Perceived Ease of ICT Use to **Present Info**	**Current Daily Usage inside of Classroom (Curr)**	Video (Vid) Music clips (Musi)	Share experiences in class (Exp)	Smartboard (SBoard)	Power Point (PPT)	Research on other methods (Res)	Filmed or taped videos on YouTube (Tape)	Hands-on games (Game) / Wii
		Underutilising	Beginning of	Middle of	Podcasting	Provide		

Figure 3.10. Preliminary Stages in Reducing and Recategorising the Data to Develop Initial Themes

ICT Policy			
a) Management's Role – to 'push' strategies to encourage teachers to use ICT	Check effectiveness Set up Benchmarks Let Teachers be Responsible Students' Feedback Students' Attendance as checks Management set direction Provoke or show teachers how to use new tech Principal asks staff to review software or influence and lead rather than enforce Check effectiveness of lessons rather than enforce through students' feedback and attendance Set benchmark (PPT-Min)	Man – Check Man – Bmark Man – Resp Man – Feed Man – Att Man – Inno Imp – Direc-Top Imp – Provo Imp – Show Pol – Prin-Review Pol – Soft Power Pol – effect Pol – attd Pol – fdbk Pol – min PPT Pol – min Pol – Benchmk	The 'push' role of management is really to get teachers to become aware of management's expectations that teachers should increase effectiveness in the classroom. Checks through students' feedback, attendance and results are indicators of that teacher effectiveness. Benchmarking is not of ICT but of teachers' ability to teach in general. ICT is another tool that teachers should be able to master.
Management's Role – 'pull' strategies – to draw teachers to adopt ICT interventions	Propose ICT interventions Let Trs catch their own vision All teachers to start simple Begin with available software Principal leads by example Management know the ground when they also teach students Letting teachers see ICT through sit-ins and mentor each other P & VP fight alongside staff	Man – Prop Man – Catch Imp – Simp Imp – Soft Imp – Avai Imp – Lead Imp – Grd Pol – See It Pol – Sit-in Pol – All Mentors Pol – Fight Alongside	The 'pull' role of management is to entice, encourage and cajole teachers to embrace innovation and technology. Letting teachers catch their own vision, to own their initiatives and to start small and simple are key ways of pulling teachers along. The P and VP teach as well which makes it easier for them to share their own teaching innovations during meetings. Sit-ins and mentors are expected throughout the year.

Figure 3.11. Examples of Resulting Themes and Categories

Further reference and alignment with the key research findings from the literature cited in Chapter Two provided useful inputs to the initial theme generation process. According to Yin (2009:p.128),

> *'developing a rich and full explanation … will require much … thinking and analysis on your (researcher) part.'*

Deciding which themes to highlight requires careful analyses with the focus on the 'how and the 'why' to illuminate the issues raised in the literature and the research questions. However, when the findings deviated from the literature, further analyses were conducted to resolve the discrepancies. In general, the initial themes are to provide some directions as to how the data analyses can proceed further in a meaningful manner.

Examples of the overarching themes aligned with 'Pedagogy' are as follows:
1) Student-Centred
2) Teacher-Centred
3) Balanced between Student and Teacher-Centred
4) Presentation-based

With these themes, the structure of the responses to the research questions can then be established. Inadvertently, the proposed theoretical model is based on the themes which emerge from the data.

3.14.1.4 Fourth Stage: Mapping of Interactional Patterns among Teachers

The interviews revealed that teachers have affinity to ask for help or to collaborate with specific colleagues when working on ICT projects. This led to follow-up interviews and qualitative surveys which tracked the interactional patterns among the teachers as a matter of investigating approach to putting teachers together for ICT projects. Interestingly, when teachers were asked to put down the names of teachers they work with to implement ICT projects, the frequency and manner of the interactions as well as the nature of the ICT project, most teachers could cite the names within seconds. This quickness can be attributed to the relatively high frequency of the interactions and the small staff strength in an enclosed staff room

which contribute to ICT projects being implemented at a fast pace. The qualitative survey required teachers to indicate the colleagues in Cool School they interacted with most frequently over ICT-related issues. These issues could be associated with technical support or ICT projects. From the names indicated, a table was constructed which showed the number of staff whom the teacher initiated interaction with and whom others initiated the interaction with. See Table 3.7.

Staff	No. of staff whom the teacher initiated interaction with	No. of staff who initiated interaction with the teacher	Average	Difference
P	5	5	5	0
VP	5	3	4	2
S1	5	3	4	2
S2	3	5	4	-2
H3	2	0	1	2
S3	5	4	4.5	1
M3	5	3	4	2
H2	3	0	1.5	3
L3	4	1	2.5	3
M2	3	4	3.5	-1
L1	No response	6	6	-6
S5	5	2	3.5	3
S4	4	4	4	0
L2	5	2	3.5	3
T2	0	4	2	-4
T1	3	8	5.5	-5

Table 3.7. Interactions Among Teachers for ICT-related Issues

Following which, an interaction chart was constructed with specific colours representative of certain frequencies and nature of interaction. This chart presented useful data on how the teachers interacted among each other and the boundaries drawn up which grouped the teachers naturally. More findings of the analyses will be presented in the Results chapters.

3.14.2 Documentation Analyses

The webpages were analysed and categorised according to how they contributed to the overall effectiveness of the ICT-based lesson. For example, a blogsite may be used as a portal for student submission of assignments. In this case, the document (blogsite) will be categorised as using ICT for ‘production’. Some webpages are used

to place hyperlinks to video clips for the students to view. These will be categorised as using ICT for ‘presentations’.

3.15 Trustworthiness

In order for a study to be trustworthy and valid, it must measure what it is designed to measure (Toma, 2006). Hence, the study should report the results exactly the way they are measured and possible implications without subjectivity or bias but in reality, it is difficult to ensure unbiased reporting.

According to Lincoln and Guba (1985), the trustworthiness of a research study is important to evaluating its worth. Trustworthiness involves establishing 4 criteria. See Table 3.8 below.

	Criteria	Definition	Techniques to Achieve Criteria in Study for CH
1	Credibility	confidence in the 'truth' of the findings	Triangulation & Member-Checking
2	Transferability	findings are applicable to other contexts	Thick description
3	Dependability	findings are consistent and can be repeated	Inquiry audit
4	Confirmability	the extent to which the findings of a study are shaped by the respondents and not by researcher bias, motivation, or interest	Audit trail & Triangulation

Table 3.8. Criteria for Establishing Trustworthiness

Hence, it is important for readers to make conclusions based on a range of studies and for researchers to clearly define the boundaries of their research, justify their sampling procedures and the assumptions made so that readers can make their own informed judgment.

3.15.1 Establishing Trustworthiness

In order for the proposed research study to be trustworthy and valid, several measures were taken (Lincoln and Guba, 1985):

a) Triangulation procedures – to check and re-check data collected from different sources (teachers, school leaders and technical staff). Methods of data collection would range from interviews to observation of school environments to collection of documents.

b) Member checking to ensure accuracy of the data collected. According to Lincoln and Guba (1985) member checking is the most crucial technique for establishing credibility. The collected data is 'played back' to the teacher to check for perceived accuracy and reactions either by asking the teacher to verify that the transcript of the interview is accurate or to email the teacher for verification once the transcript is complete.

3.15.2 Credibility

To ensure the results from the study is credible, besides retaining the voice recording, member checking through emailing the transcript to the participant is also conducted to ensure accuracy and of course, credibility. Further questioning of particular incidents or policies with different teachers assisted in ascertaining if the data presented by the teachers were reliable (Yin, 2009). Analyses of different types of data from webpages, interviews and questionnaires also provided convergence of evidence which contributes to construct validity.

As mentioned in an earlier section on active interviews, the trustworthiness (or more specifically, the credibility) of the study can be undermined with the active interviewing approach since teachers may give comments in relation to what they perceive to be desired by the interviewer. To maintain credibility, data triangulation with the school management and other teachers was carried out. Checks on the projects mentioned (e.g. use of video clips in class) were conducted by asking other teachers on how these clips were utilised in their department. Corroboration was achieved with the collection of documentary evidence (e.g. presence of video clip on the department blog). Subsequent checks were made with the teacher at a later stage if there are doubts on the credibility of statements made to mitigate any effect of active interviewing or insider research bias.

3.15.3 Transferability

'Thick' descriptions of the findings are provided in this study to allow readers to make an informed decision as to whether the contexts are relevant to them. Besides the 'how', significant space is dedicated to the 'why's so that the cognitive and social processes that occurred in the school are also clearly expounded for the interest of the reader.

3.15.4 Dependability

The issue of dependability centres around providing enough information for an informed judgement to be made concerning the findings from the study. This is done through including an audit trail (Yin, 2003) detailing the reasoning behind the modifications made to the study. For example, the study provided the rationale behind the change from public schools to private schools and refinements to the research questions were also made known to allow readers to have a clearer understanding of the challenges and limitations involved.

Concerns that the dependability of the data may be affected due to active interviewing were addressed earlier.

3.15.5 Confirmability

Audit trails have the purpose of increasing confirmability by means of revisiting facts, feelings, experiences and beliefs collected and interpreted through reflection. By having my personal experiences, biases or opinions recorded prior to and during the study in particular, it is hoped that potential subjectivity could be spotted early and strategies could be developed to prevent any reduction in the validity of the collection and analyses of the data. My friendship with the school management could aid in the collection of data since trust has already been established but some teachers may be cautious to reveal too much while others may want to reveal more due to my current position on the Board. Hence, further probing and trust-building may need to be carried out during the interviews to maintain transactional validity.

3.16 Ethics and Confidentiality

Before embarking on the study proper, an application was submitted to the University's Research Ethics Committee for approval. The application included details of the research, the proposed methods, details of the participants and the potential risks and benefits to the participants. Additional measures were put in place to ensure the participants' rights were not violated.

3.16.1 Right to Privacy

While the integrity of research needs to be preserved, the researcher has to also maintain respect for the participants' confidentiality, dignity, interests and rights (ESRC, 2008). Due care and respect is taken to ensure minimal disclosure of their identities through the use of pseudonyms in reports. Unreasonable amount of distress or embarrassment during the course of the study should be avoided at all costs (ESRC, 2008).

3.16.2 Informing Participants

Prior to the start of the pilot studies, the teachers involved were emailed a proposal of the study (See Appendix 1). In the proposal and before every interview, the teachers were briefed on confidentiality and anonymity issues. As promised, pseudonyms are used to protect the identities of the teachers involved.

3.16.3 Reducing Conflicts of Interest as Insider Researcher

There is a lot of literature on insider researcher, expounding both the advantages and disadvantages on the issue. One advantage is that it allows the insider researcher to develop professionally (Jaworski & Goodchild, 2006). However, insider research also implies a familiarity or pre-understanding of the issues being discussed (Mercer, 2007). This familiarity with Cool School and its operational approach provides me with the context to analyse the findings efficiently and with meaning. The same familiarity can also result in researcher bias as I become 'blind' to certain observations due to over-familiarity with what the respondents say. In other words, my pre-conceptions may result in me reading into the responses the way I want to, not the way they should be perceived (Mercer, 2007). To reduce the

familiarity bias, I had to be constantly reflexive and mindful of how I was reading into the responses or how I replied to the teacher's responses. I took pains to probe further even if I knew what the teacher meant, just to be clear. During each interview, I made brief notes on the teachers' responses and to check if I had unconsciously influenced the interview process.

The voice recording allowed me to return to the interview for further checks if I exhibited pre-understanding bias. There were instances when I pre-empted a teacher in her response by completing her sentences which implied pre-understanding based on our shared context. Upon reflection, I had to consciously stop myself doing for the remaining interviews so as to reduce further influences on the responses. As I maintained regular correspondence with the school and teachers, I could also check with the teachers what they meant to ensure objectivity.

In this particular study, most of the teachers trust me due to the position of Directorship that I held in the school. They are also generally open to share their practices in the classroom, especially practices deemed as successful. On the other hand, my position and my proximity to the school management may create a power imbalance which could cause some teachers to hesitate revealing too much information on their teaching practice. Understandably this creates some bias in the data collected and analysed. Unfortunately, this bias cannot be removed completely but I have taken steps to minimise it. I am careful to draw the line between my roles as Director (voluntary) and as a researcher. Questions asked pertained only to the study and I was prepared to steer the teacher back to the study if the responses were sensitive or irrelevant to the study. It was during the later part of the research that I resigned as Director that there was less of a need to clarify to the teachers that I was there solely to conduct research. To some extent, my acquaintance with some of the teachers led to them being freer in their responses. Hence, I have to be careful to not pass on the information shared in confidentiality with others, including the management, based on ethical grounds. Having articulated these issues, it must be stated that most of the teachers were positive in their comments during the interviews and were highly satisfied with the school and the school management. There was also one teacher who rejected participating in the study and her choice was respected.

3.16.4 Issues Arising from the Interview and Qualitative Survey Process

Fodder (1993) argues that the interview process is problematic due to inherently subjective process of coding and decoding the terms and references used in conversation. The respondent may interpret parts of the same question differently from the interviewer (Fodder, 1993). Thus, it is very important to check the assumptions the respondent makes in his or her use of words and phrases (Charmaz, 2006). I am also careful to follow-up with the respondent if there are areas of confusion or misunderstanding.

3.17 Generalisation of Findings

The implication of adopting the interpretivist paradigm is that studies may not be able to derive results that have 'generalisability power' as compared to positivist studies but on the other hand, such interpretivist research studies can be more valid (in reference to the sample group examined) than large positivist studies yielding enormous databases with numerous variables but little meaning especially across samples that are highly diverse and complicated.

3.18 Conclusion

It was the analyses of the interview data which presented the greatest challenges. Firstly, the large amount of data generated from the face-to-face and written interviews took a lot of time to transcribe and categorise. Secondly, mining the data through reviewing the transcripts and analysing the categories from the coding exercise proved extremely tedious. The process was highly iterative as I had to revisit the transcripts to see if the data fitted the themes originally used to structure the interview schedule. The 'mix-and-match' structure of the codes used to classify the 'significant classes of things, persons and events… and its links with another' (Marshall et al., 1999:p. 152) was useful for quick interpretation and searches.

Each broad category represents a key item of interest and indicates the type of ICT use in the classroom or the difficulties teachers face in implementing ICT. The data are not presented in any order of priority or importance due to the difficulty in quantifying the importance of the responses to the respondents. With qualitative

data, it can be difficult to re-present the data in a graphical or quantitative form so the findings are presented in anecdotal or quotation format.

Finally, this chapter established that the reasons for using the interpretivist paradigm and the atypical case study as a method (Yin, 2009). Measures to ensure trustworthiness through increasing credibility, transferability, dependability and confirmability were also discussed and particular attention was given to ensure that as an insider researcher, sufficient measures were put in place to reduce bias in both data collection and analyses.

CHAPTER 4: RESULTS CHAPTER

4.0 Introduction

This chapter presents a summary of the data collected from the interviews (including follow-up interviews), webpage analyses and qualitative surveys.

The SRQs along with the key findings are presented in Table 4.1 below:

	Specific Research Questions	Correspondence with Hypertext Function Model	Method
1	What are the teachers' and school leaders' perceptions towards the use of ICT in the classroom?	Familiarity (with Pedagogy)	Interviews
2	What are the teachers', school leaders' and technical staff's perceptions towards the available ICT infrastructure in Cool School?	Facility (Familiarity with Technology)	Interviews
3	How do teachers and school leaders view the link between technology and teaching?	a) Transparency (inserting ICT into curriculum) b) Connectivity (connecting content using ICT)	Interviews Documentation (Web pages)
4	How do the management and teachers collaborate to implement ICT initiatives in the school?	Collegiality (Peer Support)	Interviews & Qualitative surveys
5	What are the teachers' and school leaders' perceptions towards the ICT policy in Cool School?	Collegiality (Management Support)	Interviews

Table 4.1. Specific Research Questions and Key Findings

4.1 General ICT Use in Cool School

Even though the majority of lessons in Cool School are conducted using PowerPoint slides, SmartBoard presentations and Tablet PCs, teachers are generally utilising ICT in a mostly didactic manner in the classroom, an observation similar to the findings in Becta (2009)'s study. For example, M2 gives an idea of how she uses ICT in her classroom:

[ICT is used in] every lesson…basically mostly slides, and sometimes internet. Not so [interactive]… Interactive-wise will be the SmartBoard…I use the SmartBoard …twice a week [M2]

M2 admitted that her use of ICT (except SmartBoard) tended to be less interactive. One key reason is the lack of personal ICT equipment for individual students in class. An alternative is to utilise what is already available in class such as students' mobile phones and iPods (Rau, Gao & Wu, 2008). The latter is more resource-friendly and may prove more motivating to the students since the ownership belongs to the students. Besides experimenting with ICT which belongs to the students, Cool School teachers are also grappling with other new technologies and pedagogies in engaging students.

Section 4.1 will lay out key findings in relation to how Cool School teachers and school management implement ICT initiatives and the successes and failures encountered. It will answer the first SRQ:

SRQ 1: What are the teachers' and school leaders' perceptions towards the use of ICT in the classroom?

Interestingly, despite the differences in responsibilities and roles between teachers and school management, both generally agree that the use of ICT is important to help students learn better. For example, the Principal highlighted the effectiveness of using video clips to present information:

‘Certain things could be painted better with the picture, video. That is very convenient… you help [students] to retain certain information.’ [P]

His views were mirrored by H2 in a separate interview. H2, as a Humanities teacher, cited the importance of using video clips as a means to present information and messages to the students, something that texts may not do as well. She emphasised:

‘But video is very powerful because it captures everything that you say in images. For example, I cannot teach history without video...[from] YouTube …[although] YouTube’s disadvantage is that it is a very short clip.’ [H2]

Part of the reason for the alignment in perspectives between school management and teachers could be attributed to the school management also taking on teaching responsibilities. In the seven years that Cool School has been in operation, the Principal taught Physics in the first five years and stopped for a year (last year) and went back to teaching Economics the year in which the research was carried out. He felt that he had to get back into the classroom during this year to connect with the students and teachers again.

‘The year before, I didn’t teach as much. Then, I feel that I am not as connected so this year, I taught all the two-year programmes because those are the more challenging cases.’ [P]

The Vice-Principal takes on a full teaching load, teaching Mathematics, on top of his administrative duties. Through leading by example, the Principal and Vice-Principal are able to influence teachers to employ ICT in classroom teaching. The shared experience also bonds teachers and management together. As such, it is probably helpful to describe the findings from the two groups together, intermixing the teachers’ views with the management’s, to form a more holistic picture of the school’s approach to ICT implementation.

4.1.1 General Perceptions toward ICT use

Both teachers and the school management (Principal and Vice-Principal) recognise the importance ICT play in the current and future world. Cool School embraces ICT out of a practical necessity so that the education that their students receive will equip them with life skills to take on future jobs. According to P, the world of the future entails intelligent processing of information.

'First is the availability of information so the world that our graduate would go into … is a world with too much information…I think that ICT...has to be (about)…practical usage.' [P]

Hence, equipping the students with the right skills to manage the future becomes crucial. According to P, the world of the future is about ICT and so ICT should be utilised as a tool in school:

'…a majority of them don't really know how to use email, search engine. It seems like they are only going to pick it up…when they go out to work which might be late…The curriculum …has to include such skills, which is quite vital if they want to be relevant.' [P]

Recognising the importance of ICT skills for their students, Cool School embarks on an ICT infusion programme to expose their students to ICT skills and resources. S2 adds that despite the additional work, ICT will make the lesson more interesting and creative.

'Using ICT takes up a lot of time. Sometimes we are so tempted to use our last year notes, very tempting but we tell ourselves that no we have to teach in more creative way so those things take a lot of time…' [S2]

More importantly, teachers perceive the importance of ICT in making lessons more effective in different ways.

4.1.2 Perceptions of ICT as Teaching Tools

As ICT is used in many different ways as teaching tools (Chapman, 2004), it is necessary to consider how to structure the data generated from the interviews with the teachers so that the findings make sense. As mentioned at the conclusion of the literature chapter (page 52), ICT can be categorised for use as:

1. a motivational tool
2. a presentational tool
3. a production tool
4. a collaborative tool
5. a research tool
6. an interactive learning tool
7. others

These categories will be examined against the findings from the study to see if they are encompassing enough and if new categories are needed to accommodate the data.

4.1.2.1 ICT as a Motivational Tool

Similar to the principals and ICT coordinators in Zander (2004)'s study, teachers in Cool School use ICT as a means to get students interested in the topics. S2 (Science Teacher 2) described how he would start a lesson by using an interesting video clip to capture students' attention. According to S2,

'The ideal lesson is to start off with an inspiring and motivational [video] clip and after that, weave it into your lesson… let's say I'm teaching kinetics, I will show them a clip about someone paragliding or the latest moving plane. [Show] something relevant, then teach them the topic.' [S2]

S2's approach is to help students see the applicability of the concepts or skills. With the realisation of the usefulness of these concepts or skills, the students become motivated to learn.

'…if it is a new topic, I will start with a video clip…I will show them another clip to relate to what they learn. So the introduction is like the phenomenon you see in everyday life, like the Bermuda Triangle, or the North Pole, to introduce the topic. Then I can show them another part to relate to the topic.' [S2]

The need to explicitly show that a concept is relevant to real-life application is especially necessary to the students in Cool School, partly because of their aptitude and attitude towards schooling as many of the students dropped out of mainstream schools before enrolling in Cool School on their own. The use of ICT to interest students is prevalent among teachers in Cool School. For example, M3 often uses ICT use to capture students' attention and interest.

'ICT is used…70% [of the time] on capturing attention. In order to get people to learn, you need to get their interest.' [M3]

Conversely, forcing them to go through a lesson to learn abstract concepts that they cannot appreciate will often not work for them. For example, Language Teacher 3 (L3) cited how students responded to topics which do not interest them.

'…our intellectual capacity is much more than theirs [students]. You may find a documentary on Egypt pyramids interesting…[but] they will be like 'What the heck'.' [L3]

From the interviews with the teaching staff in Cool School, one very important trait that they displayed is that they know what their students are interested in. This trait is the result of the teachers 'connecting' with the students through interacting and working with them over a period of time. By using ICT resources which mirror their interests, the teacher can ensure student interest. For example, L3 talked about using music videos to make her lessons come alive:

'…a lot of them grew up on MTV and stimulating images so I think they see the videos connect with their sense of gratification. They get to see fast pace images they like.' [L3]

Satisfying the sense of gratification in the students may not seem pedagogically useful or effective from the learning perspective (Zander, 2004) but teachers argue that ICT is helpful in getting the students interested in the lesson. By eliciting and associating the gratification feeling with school, teachers send a subconscious message that lessons are fun and rewarding. Besides Music Television (MTV) video clips, computer games are also mentioned as an effective attention-grabbing ICT resource.

'Because they're always seeing television, computer games, they are used to dynamic pictures so if you use static pictures, it is unable to capture their attention…We [should] have the lesson as interesting as the games they are playing…'[S1]

With students being surrounded by ICT in their daily lives (e.g. mobile phones and personal computers and iPods), motivating students through the use of ICT seems a natural choice (Domitrek & Rabv, 2008). Remaining relevant to the students is important, as VP remarked:

'[Cool School] has always tried our best to be on the edge-trying to be relevant…the 'in thing' now is to use Twitter…If [teachers] can run ahead, better still. Just don't stay behind.' [VP]

A common thread that runs across the interviews concerning teachers' perception of ICT use in the classroom so far seems to suggest that ICT is used primarily to enhance students' interest in school. However, Cool School students may not exhibit the appropriate attitude to benefit from the ICT interventions at times. For example, L3 complained about the difficulty of getting the students to go beyond just enjoying the video clip to learning the key concepts.

'…some of them are quite lazy. They thought they can watch the film and forget about the text.' [L3]

Apparently, this phenomenon of being engaged in enjoyment and unengaged in learning is not uncommon. Barnes *et al.* (2009) found in their studies that ICT

generally excites students but it does not necessarily facilitate deep learning. The challenge for teachers, having gained the students' interest, is to continue to draw on the gained interest and maintain their interest throughout the learning process.

4.1.2.2 ICT as a Presentational Tool

To facilitate learning, teachers also use ICT to present information which in many ways can be more captivating than the information presented in the textbooks. ICT such as PowerPoint software, video clips, a projector and a computer allow visual information to be presented easily to the students. Teachers use these ICT resources to present new concepts, new environments and ways of thinking. As pointed out by S1, ICT can bring new environments into the classroom when she cannot take the students out into the world.

'I can't even bring them to see an invention but by using video clips, it's like bringing them out of the classroom. They can see the pictures, the emotions…they can see the dynamism of it.' [S1]

H3 related how ICT provides an avenue for her students to explore physical geography beyond Singapore without having to actually travel overseas.

'Singapore doesn't have any physical [Geography] so to them they are studying something that will never happen… They are very interested…but…many of them cannot travel, don't have the money to, so they will use the internet.' [H3]

Clearly, when using ICT to present visual information, the students need to move beyond being interested in the ICT media (e.g. MTV videos) to being interested in the concepts being presented. This shift in focus is of paramount importance as it signifies the students' willingness to work with the teachers in learning the concepts. Several teachers (e.g. S1, VP, H2, L3) mentioned that the students can better visualise the information when they use slides, video clips and other pictorial means of illustrating a concept. For example, S1 said,

'…it helps students to remember and understand better. Yes because they actually see the thing doing…If it is just based on the notes, they cannot see the motion pictures.' [S1]

Similarly, VP mentioned about the value adding that ICT brings to a Mathematics lesson, to help the students see how Mathematics can be applied to real life:

‘The use of ICT has two very important components for me: One is it helps to bring out …illustrations that cannot be done in actual life…. for example, modelling, like scale of 1:20000 can never be done (in real life)…The other is to have differentiated learning where the people can learn at their own pace like using Facebook to upload a video or a lecture where students can before or after [a lecture to review it].’ [VP]

The following image (Figure 4.1.) shows the use of video clips to teach the process of constructing triangles in Mathematics in real life.

[Deleted screenshot of website]

Figure 4.1. A Screenshot of a Website with YouTube video clips showing how Mathematics Questions can be Solved

The visual presentation of information through PowerPoint slides or video clips can be effective in helping students understand the concepts in a safe and yet realistic manner. The manner in which ICT is used and how it fits with the overall teaching strategy of the lesson are important considerations as sometimes, ICT when used inappropriately can be a deterrent to learning, especially when too much information is presented or if there is no change to the mode of presentation. It may put students off learning instead. For example, S3 cited her personal experience of attending an online lecture which bored her:

‘You will see a person teaching and…the PowerPoint. Honestly, I don’t like it. The worst is the person… just talking…I still want the human touch, the interaction.’ [S3]

As a presentational tool, ICT can be effective in illustrating the information to the learner in a highly graphic manner. However, according to Harasim et al. (1995), there are learners who may benefit more by learning in groups or through a more experiential approach such as S3 who is quoted above. M2 makes it a point to use the SmartBoard to enhance student participation:

'[ICT is used in] every lesson…basically mostly slides, and sometimes internet. Not so [interactive]… Interactive-wise will be the SmartBoard…I use the SmartBoard …twice a week.' [M2]

Correspondingly, there are teachers (e.g. L1, L3, M2) who believe in a more constructivist approach to teaching and are disinclined to use ICT (purely for presentations purposes) in place of learning activities such as games and discussions. They feel that these learning activities have not yet been fully exploited and are more effective and inexpensive compared to PowerPoint slides or video clip presentations. For example, L1, an English Language teacher, prefers to use other teaching options for her lessons instead of slides. She argued:

'[Not using ICT in class] because there are so many options that we have not researched yet. ICT is only one of them.' [L1]

What some teachers, including L1, find effective in addition to using ICT as a visual presentation tool is to engage students through production work and collaborative learning. These forms of learning ensure a more active role for the student to play and when used in a carefully controlled environment and manner, the students' motivation to learn with and from others is very much increased.

4.1.2.3 ICT as a Production Tool

The third mode described here has to do with using ICT as a production tool. This involves getting students to respond to online quizzes, make presentations and respond to assignments posted online. Compared to ICT as a presentational tool where the students receive the information via ICT-enabled presentations, ICT as a production tool involves the students using ICT to provide information. The following examples of production-based ICT use were cited by L3, M2 and M3. On the English Department blog, L3 instructed her students to view and comment on a video clip so as to provide students with opportunities to practise summary writing skills. Compared to the earlier functions of ICT use, this approach focuses on students' performance than their learning, although it is also arguable that the practice may also lead to the consolidation of student learning. However, the focus in production is that students are expected to show what they know rather than focus on learning a concept. L3 described her approach below:

'[ICT is used] for essay writing…They watch something and write about it. I think some of them use summary skills…watch the Simpsons and what are the things that Homer Simpson didn't like.' (L3)

Hence, by using a blog, teachers can employ ICT for both collaborative learning and for production purposes. Beside the Language Department, the Mathematics Department is also exploring production-based ICT. M1 expanded on what ICT-enabled assessment could look like:

'[Online assessments are] not [implemented] yet because the number of iPod [is] limited. We will try that once the IT stuff comes in. This is one of the ideas. Then the assessment can be marked immediately, of course if [it is in] multiple choice.' [M1]

In the case of M3, who is also from the Mathematics Department, she explored using her Tablet PC for students to write their answers. By using a long VGA cable connected to the LCD projector, she could move around the class and get different students to respond. She added:

'I pass my Tablet to them, where they can come up and write answers on the laptop, which they find very amusing.' [M3]

Hence, by using a tool which primarily is presentational in nature for the students and switching it into a production tool, M3 exhibited pedagogical flexibility and creativity. This switch in function leads one to consider if specific types of ICT require certain pedagogical skills. When M2 switched the use of the tablet PC, she had to utilize a different set of skills to maximize the impact of the ICT resource on teaching and learning. Perhaps it may useful to review how pedagogical skills change as the functional use of ICT changes, for example from presentational to production, as in the case of M3. Are the pedagogical skills more complex as one shifts from motivational to interactive learning? If a normal laptop was used instead, would M3 be able to carry out the switch from 'presentation' to 'production' in any way? It may suggest that the type of ICT used and specific pedagogical practices are linked. These issues will be further examined in the Discussion Chapter.

M3's use of ICT as a production tool was relatively successful but there are other examples of such uses which failed. Similar to the findings in Rau, Gao & Wu (2008)'s study, the Cool School students did not take to using SMS to respond,

'[I asked the students to] SMS their response [in class]…we did that once but it didn't kick off.' [M2]

The willingness of the students to pay for the additional SMS sent is a key reason contributing to the failure of this strategy. While the concept seems sound, there are other limitations such as the students not being able to draw and send diagrams.

In contrast to ICT as a presentational tool where the teacher gives the inputs, ICT as a production tool involves student outputs in the form of student presentations or work submissions. There may be instances whereby the teacher is on hand to give some feedback (for example, M3's use of tablet PC) to make it somewhat interactive.

4.1.2.4 ICT as a Collaboration Tool

To use ICT for collaborative learning, there are some tools and resources which are available at little or no cost to the students or school. Due to its low cost to the teachers and students, such 'cheap' technology allows teachers to experiment with using online collaborative methods for learning purposes. Informal discussion platforms such as FaceBook and blogs can provide the online space for students to discuss key issues together or to interact after school hours. This form of engagement may or may not concern learning directly but is important for building strong teacher-student relationships within the school. H2 cited an example of how FaceBook is used for discussion of fashion:

'…most of the young people nowadays…go on to Facebook 5 to 10 times a day. When I have Facebook, I will send reminder [of due assignment] to them…For example I can create a fashion group where people can join and we talk about fashion.' [H2]

By using FaceBook and blogs as a communication platform, teachers can further extend the use of blogs for learning. Besides facilitating interactions between students and teachers, there is a high volume of interactions among students as well. If teachers can provide a safe online environment for discussions, the students will contribute their own opinions to the topic. For example, Figure 4.2 below shows how students can use blogs to comment on current issues in social studies.

[Deleted Blog]

Figure 4.2. A Blog on Issues Related to Social Studies

Hence, ICT can provide students and teachers with an alternative platform after school hours to discuss key topics mentioned in class. Cool School teachers

perceive this use of ICT as a natural extension of what routinely occurs in their daily lives with the students.

There is, however, a downside to using ICT for collaboration. S3 highlighted the role of the teacher in imparting values and setting guidelines for right behaviour which implies that human interaction should not be completely replaced by interaction with ICT tools. L3 described how ICT use can inhibit face-to-face communication and reduce verbal skill acquisition, especially during English lessons.

'…I like to use ICT, but when I want to question more, I won't use ICT but do more face to face interaction…I am doing (that) now in a foundational course for English…to give more questions and time for thinking and reflecting...auditory and verbal skills.' [L3]

This issue about ICT reducing verbal skills was also mentioned in Barnes et al. (2009)'s study about how ICT use reduces opportunities for discussions or debate in class. The irony of using online discussion in class when face-to-face interaction is possible is not lost on teachers. In the examples listed above, most of the online discussions are conducted after school or during school holidays and so they complement rather than disrupt or reduce classroom interactions.

In general, Cool School teachers (e.g. L1, L3, H2) perceive ICT as useful for collaborative learning and after-school discussions. However, classroom activities and discussions are preferably conducted 'live' with their students so that teachers can train their students on their verbal and auditory skills, something which students cannot acquire through interactions on FaceBook or blogs. Once the students have begun collaborating with each other on the school or class blog, a natural extension to online collaborations is to use ICT for research purposes.

4.1.2.5 ICT as a Resource for Research

In Cool School, students who enrol in the 2-year programme have opportunities to carry out a mini-project which requires them to conduct research, much of it online. The challenges the students face in conducting online research are listed by H3:

‘They have to know how to do research. We are not surprised that a lot of them just ‘huh how to find this’ - things like how to register [online]. To them they have to be [spoon] fed. ICT can really [allow them to] explore and hopefully expand their capacity.’ [H3]

This exploratory process requires students to go beyond scanning the information collected but also to analyse and evaluate the usefulness of the information for their project. T1, the technical officer in Cool School, commented on the usefulness of getting students to use the Internet to complete their research projects:

‘It (ICT) teaches them how to find solutions…gather information…interpret it, analyse the data and then, to help them to do their assignment or project better.’ [T1]

Separately, the Principal talked about the importance of teaching students to evaluate the information wisely. The whole process of interpreting data is cognitively demanding and one that is highly interactive and experiential. He emphasised the need to empower the students with the right research skills here:

‘…teach them how to mine data, how to ask the right questions and how to decipher those questions…But I feel that the minimum that we have to do is to let them have access [to ICT].’ [P]

The converse to providing students with greater exposure to worldwide applications is the risk of overburdening the students with too much information. Due to the amount of information available online, students now have the onerous task of extracting the more important and credible information in order to learn about a topic. H3 warned about overwhelming students with too much information:

‘… disadvantage would be…an information overload. There will be so many websites telling them so much stuff about one small little thing. Then sometimes they just ahh…[give up]…and think it’s very difficult.’ [H3)

Compared to ICT as a presentational tool or a collaborative tool, the use of ICT (in particular, the Internet) for research is much less teacher-controlled and there is the

danger of students acquiring erroneous data or engaging in unethical and illegal behaviour. The argument for using ICT as a resource for research is to provide students with the experience in finding their own solutions to the problems and this can make learning interactive and experiential.

4.1.2.6 ICT as an Interactive Learning Tool

As highlighted earlier, there are teachers such as L1 and M3 who are not inclined to use ICT purely for presentations as they reduce opportunities for hands-on activities. According to these teachers, ICT use in these instances will fall into Type 1 category in Maddux & Johnson (2005)'s model (see Chapter 2, page 33) of highly teacher-directed with a didactic form of instruction. H3 shared her own Type 2 pedagogical beliefs:

'…of course, student-centred because if it's teacher-centred, we [teachers] have all the knowledge...We don't need anymore. We just need to make sure that the relevant information inspires the kids to learn more.' [H3]

When teaching Social Studies, H3 employed ICT to facilitate a mixture of collaborative and experiential learning activities. In particular, the experiential learning activities mentioned briefly by H3 included learning games for the students:

'They ask [about] school work, chat with me [on] Facebook. No video conferencing but I find some games, Java script kind of videos and of course, movies. I did show them from Youtube, explained some theories [via FaceBook].' (H3)

Despite some teachers such as H3 possessing pedagogical beliefs that giving students hands-on experiences is most effective for learning, there were few indicators of how this is implemented through ICT use. The interviews revealed few examples of how teachers actually implemented Type 2 ICT use. H2 mentioned how the teachers managed to find appropriate learning games (using PowerPoint) for the students to play at home:

'Recently, they [teachers] found a website with very good PowerPoint games. It is quite interesting… We sent them (an) email and said [that] this is the place you can go…the students liked it as a game.' [H2]

An example of an online learning game for the teaching of probability which M3 found involved 'Deal or No Deal':

‘Teach mathematics. Oh yes we do, ‘Deal or No Deal’ via the online game so we did that with the kids to teach them about probability and making choices. That was a one off thing, one of the topic we could apply.’ [M3]

Besides these examples, the teachers interviewed could not remember lessons for which the students learned through ICT games in class. One factor contributing to this observation has to do with the limited resources available to teachers. There is little available ICT material for experiential learning. The VP explained:

‘Software-wise, we use what is available. We don’t have customised software for teaching. We have not bought any customised [software].’ [VP]

As most of the ICT resources are ‘open source’ materials, the teachers are not restricted to any platforms or software usage and hence, could exhibit creative approaches to ICT use. In this regard, it is a distinct feature of Cool School compared to government schools. In addition, there is no ICT laboratory although four computer terminals were installed in the library during the last phase of the research. However, these four terminals will not be sufficient for a class of twenty students to work on. The lack of ICT resources forms a barrier for experiential learning and as a consequence, teachers end up presenting the information rather than have the students individually work on the data themselves. For example, S2 had to illustrate visually what the effects are when data are inputted into the formula for motion. Describing the current situation,

‘…the best is when i give them the [software] programme and they key in and try but right now, [the situation] is that I ask them to give me the values and I key into the computer.’ [S2]

Despite the lack of ICT facilities, the teachers do make attempts to get students to engage in their own learning either at home when they can work on their own computers by conducting their own research or to answer questions posted on the blogsite or FaceBook. These initiatives while not exactly experiential in nature (compared to navigating through an online learning maze or an online learning journey) show the teachers’ willingness to improvise with available resources and

more importantly, the constant quest to engage their students in meaningful and effective learning. Attempts to use 'cheap technology' are limited by what is available online and often, these resources are not customised to the Singapore syllabus and so are inappropriate for use.

Similar to the findings by Slay *et al.* (2008), the SmartBoard, despite its name as 'interactive whiteboard', did not help to enhance interactivity within the classroom. The interactive whiteboard does not allow students to work with it unless they come to the front. M3 noted the limitations to the use of the SmartBoard:

'… there are limitations… to the [Smart]Board - students can[not] get to use hands-on, because SmartBoard can only handle single touch …[if] we don't have hands-on to let them feel, touch, they will not find learning interesting.' [M3]

4.1.2.7 Other Categories of ICT Use

Besides the categories of ICT use mentioned in the six sub-sections described above, a careful search of the data revealed a few other possible functions of ICT that teachers use with students. They include:

- Revising concepts
- Learning guidance
- Giving advice

Concerning revision of concepts, teachers adopt 'push' technology to get the information out to the students by emailing their PowerPoint slides with annotations. The purpose of which is to assist students who are absent or who want to revise for their tests. M3 described her use of a tablet laptop in the quotation below:

'Every lesson, because we use PPT to teach and with the help of a tablet laptop, we can actually write on the laptop and save all our handwriting, so we can send to the students who are absent or need it to revise nearer the test.' [M3]

While M3 utilised ICT to help her students revise, S2 mentioned his own experience of students asking him questions at night about the information he posted on the blog. S2 highlighted:

'One of the classes started with a class blog so maybe I can post a question on the blog…the students have my MSN so they ask me questions. Sometimes in the middle of the night doing their homework, they can ask me, "Sir what is this?' [S2]

S2 utilises ICT to ask questions as well as to answer queries. This form of unstructured learning guidance is important to students with low self-esteem as they may not want to ask questions in class but are open to asking through blogs or FaceBook. While it may not be obvious in the quotation above, it is also highly likely that correction of views or answers can also take place using ICT (e.g. discussions on blogs). It may also be seen as less threatening to be corrected via ICT rather than face-to-face for the students as highlighted in the quotation by H2 below:

'…some people will make a comment that seems quite heretical. I will delete it and tell them it is not right... some students surprise me because (they may) seem quite quiet and uninterested in class or disengaged but when they are in the facebook group, they actually talk… there is probably safety in virtual reality so you are able to fish little things out…gives me a chance to assess them more objectively.' [H2]

As students can hide behind the ICT screen, ICT can be a powerful tool to manage the students' emotions and psychological well-being. Often, students were willing to share their struggles and concerns online when they may not want to share them face-to-face with the teacher. L3 reflects this similar tendency of students to use ICT for coping purposes.

'(blogs)…but that is not for learning, more for emotional coping. Sometimes I read their blogs so I can find out what they are doing…Then my kids will read my personal blog…even the non-compliant ones. They will skip the class but read my blogs. I have no idea why.' [L3]

With blogs providing an electronic screen for students to hide behind while downloading their emotions online, students may feel that they can avoid the possible reprimand but still get the advice from teachers that they are looking for. As such, teachers use ICT to motivate or provide advice to students, for the purpose of spurring them on to work harder or do better in life.

These three additional functions (revising concepts, answering queries, giving advice) are mentioned by only one or at most two teachers and may not be a predominant function for the teachers in Cool School. However, having said that, it will be useful to consider these functions of ICT use in relation to the other six categories to determine if they deserve to have a separate category of their own. This will be further discussed in the Discussion and Recommendations Chapter.

4.1.3 Summary

The findings seem to support the notion that teachers use ICT for various functions. These functions range from teacher-centred strategies (motivational and presentational functions) to student-centred approaches (for research and interactive learning). In tandem with the changes in function are the variations in the type of ICT used from presentation equipment (LCD projectors) to interactive learning software and online portals. Depending on the type of ICT and how they are used, Cool School teachers appear familiar with ICT use in the classroom.

From the responses given by the teachers concerning their preoccupation with students' attention span and the relevance of the resources to maintain student concentration and to facilitate learning, there is some evidence that the teachers in Cool School are familiar with pedagogy and teaching. Their general focus is on achieving effective learning and, better grades for the well-being of the students. Possessing personal initiative to experiment with some aspects of ICT use through video clips, SMS and SmartBoard, the teachers demonstrated knowledge of their students' learning needs such the need to go beyond auditory and visual inputs into tactile and kinaesthetic activities. S1 summed it up precisely in her quotation concerning the mix of activities to engage the students:

'We have to choose the right time to play the ICT program [or video clip]. If you play at the wrong time you break the flow of the class because after you play ICT, they are more relaxed, in an entertaining mood. So if you're going to plan a test or quiz after that, it breaks the flow so you have to gauge when to use it. Normally I'll teach a little first then I'll use ICT to illustrate the point. Usually I weave it in between.' [S1]

Given her understanding of her students' needs and the use of a variety of activities, S1's lesson structure as mentioned above demonstrates teacher sensitivity to good learning principles in terms of weaving in teaching points and activities for learner engagement, thereby fulfilling the criteria for Familiarity as noted in the Hypertext Model although the data seemed to indicate different types of Familiarity (e.g. information presentation to facilitating student collaborations) in line with the different types of ICT being used.

Going forward, it will be useful to examine if the staff's positive attitudes towards ICT use spill over into their perceptions of the limited ICT infrastructure available in the school. Already, some of the teachers have mentioned technical and logistical concerns as one of the key factors during lesson planning. More importantly, are the teachers put off by the challenges to ICT use and if not, how do they overcome these obstacles?

Section 4.2: ICT Infrastructure

In Section 4.1, the evidence obtained from the interviews reveals a balanced perspective towards ICT use in the classroom. Teachers know the difficulties involved but believe in overcoming these difficulties to make the lesson interesting for the students. Management are aware of the difficulties and despite the challenges, seem to embrace ICT as the way going forward.

Section 4.2 examines the ICT infrastructure is available to the teachers and students and if there are any issues which hinder or facilitate ICT use in the classroom. In line with the Hypertext Function Model, this section will provide some clues on how much teachers know about the available technology (facility) for use in the classroom. In this section, the following research question is addressed:

SRQ2: What are the teachers', school leaders' and technical staff's perceptions towards the available ICT infrastructure in Cool School?

To understand and appreciate the perceptions of Cool School's staff to the available ICT infrastructure, it is useful to know the staff's ICT competence level.

4.2.1 Teachers' Motivation and Competence to Use ICT in the classroom

A scan of the teachers' background reveals that some of the teachers have a degree in computer engineering, information technology or engineering. Many of these teachers started using ICT in their school-going years and still use ICT for personal use such as emailing friends, blogging and accessing FaceBook almost on a daily basis. They are what Prensky (2001) would term as the 'digital natives'. They are also teachers with the *habitus* of ICT use (Belland, 2009). On the other hand, there are also teachers who started out teaching not knowing how to use ICT but they overcame the initial difficulties to acquire the skills on their own. These teachers are not exactly digital immigrants (Prensky, 2001) but they are not digital natives either. Both S2 and S3 respectively shared their initial apprehensions and how they overcame their fears to utilise ICT in their teaching.

'It's something new to me… initially not really [able to use ICT] but I force myself to [use it]… it has been a few years (since).' [S2]

For teachers who are unfamiliar with the ICT, they make up for the lack of knowledge and skill with enthusiasm and industry. Generally, the teachers possess a positive attitude towards ICT use even though they may not know everything about the ICT resource. They are not afraid or overwhelmed by the challenges ICT poses. Practising till they are competent at the skill, teachers in Cool School demonstrate the 'can-do' spirit. For example, S3 shared about the difficulties she faced during her first attempt at using the SmartBoard and how she overcame them.

'…like doing a SmartBoard for the first time, we overcome (the fear) only after a few times… the first time, I came [at night] to practise…PowerPoint.' [S3]

According to Mueller *et al.* (2008), as teachers conduct more ICT-enabled lessons successfully, they will grow in confidence and motivation. This gradual increase in confidence is evident from the interviews with the teachers in Cool School. T1, the technical support staff, has this to say about teachers in Cool School:

'I will rate them '8' [out of '10' in terms of motivation to use ICT]. They are a bunch of enthusiastic people...they are not fearful of technology…they are willing to...try something new…In term of PowerPoint [competence], I can give them '10' upon '10'.' [T1]

While motivation to use ICT in class is generally high among teachers, T1 added that teachers are generally competent at using ICT for personal use such as PDAs but may not be as skilled at using other similar types of ICT for teaching. One key reason is that besides having to acquire the skills to manage the ICT resource, teachers also need to also figure out how to facilitate the learning process using ICT in order to add value to the learning process.

'[They are] alright for things like PDA…Currently, we are using FaceBook as a tool itself to communicate with students…to post project and video and …discussion group… [they are] not that competent yet because it is still new to them and they are figuring out.' [T1]

Due to the teachers' wide exposure to ICT and a high motivation to learn and experiment, the teachers learn to utilise the ICT resources in a short period of time. ICT resources are well-exploited if they are effective and to some extent, popular among the students. M3 highlighted that the students liked the use of their own mobile phones or iPods for learning, similar to the findings by Rau, Gao & Wu, (2008).

'…sometimes we do our own video clips to show the students… It's a DIY movie clip. They like it because they can download it to their handphones or iPods.' [M3]

In this case, the ICT is not just the teachers making the video clip resource but also the students using their own ICT (iPod and mobile phone) for their own learning. This spells a potential paradigm shift in ICT use as teachers utilise 'cheap' and available technology – the students' own ICT resource.

4.2.2 ICT Infrastructure and Training

With a positive ICT culture and a good spread of ICT skills among teachers, there is little stopping the teachers from implementing ICT-enabled lessons except possibly, the lack of ICT facility and equipment for teachers to use in the classroom.

4.2.2.1 ICT Infrastructure and Resources

Cool School has some ICT resources not found in many other private schools and these include the SmartBoard, personal computers for teachers and wireless access to the Internet. Teachers (e.g. S3) are generally contented to work with the available ICT resources. For example, L3 and S3 indicated that they are relatively satisfied with the available equipment in Cool School although the situation can be improved. L3, in particular, mentioned the wireless internet connection (Wi-Fi) available in Cool School and this feature is not found in most schools.

'We have wireless here, most schools don't have.' [L3]

In general, teachers in Cool School are appreciative of the resources that management tried very hard to obtain, either through donations or careful allocation of available funds. As a result, teachers are reasonably satisfied with the available resources such as SmartBoard in a few of the classrooms and Tablet Personal Computers issued to teachers.

'As of now, based on the equipment I know, I am quite happy with the SmartBoard and Tablet [PC].' [M3]

S3, on the other hand, expressed some dissatisfaction with the sufficiency of the ICT resources but has chosen to remain positive.

'If you ask me, is it (resources) enough? No, but it is better than nothing.' [S3]

S3 went on to suggest putting a SmartBoard in every class but she also acknowledged that there are teachers who do not want to use the SmartBoard as it is not their 'style':

'[There are] not enough [SmartBoards]. I feel if we have money, I hope every single classroom has a SmartBoard….Some teachers will tell you that "I don't want a SmartBoard," but that is their style…the school doesn't hinder [or stop us] but it is us [who decide on what to use].' [S3]

S3 seemed nonchalant about teachers not using the SmartBoard and she accepted it as part of their choice in the approach they want to take when teaching the students. S3's use of the word 'style' seems to reflect that teachers have their own 'teaching style' which in turn, affects their choice of ICT and how ICT is used in the classroom. The implication is that schools need to be mindful of their teachers' 'style' or pedagogical beliefs before determining the type of ICT to purchase.

Besides the SmartBoard, four computer terminals were added in Jan 2010 to the library, during the time of the second phase of interviews. The purchase of these terminals is in line with the desire of the Principal (see p.111) to equip his students with ICT skills. These terminals provide opportunities for students who lack computer access at home to go online for research. See Figure 4.3 below. In addition, teachers can direct students to the library to work under the supervision of the administrative staff seated in the office next to the library.

Figure 4.3. Photograph of 4 newly installed computer terminals in the library

Other possible ICT resources which teachers and school management hope to obtain eventually include netbooks or iPads. For example, P mentioned having netbooks for the students to use and making available projectors in every class:

'…more netbooks available for the student…on the management side…we make sure every classroom have a projector… have enough SmartBoards.' [P]

This idea was confirmed by VP during phase 3 of the study that in 2011, the school will be acquiring sixty iPads as an experiment to go on a 'no-textbook' project. All the texts and worksheets will be downloaded into the iPads and students will read the text off the iPads. The VP added:

'…[in] 2011 implementation of 'no-textbook' project - a pilot test-run on one batch of students in 2011 using iPads [60 of them].' [VP]

The last interview with the VP quoted above was conducted about one year after the P, M1 and M2 mentioned the iPad idea in Phase 1. It can be observed that ICT developments occur at a very fast pace in Cool School. The preparation for the 2011 'no-textbook' project has already started and the teachers are currently, according to S2, '…putting all presentations and worksheets on iPad.' [S2]

While there is some ICT infrastructure such as Wi-Fi and SmartBoard in place in the school, there are other resources found in government schools which are not present in Cool School. Such resources include computer laboratories and a media room for editing video or photo images. For the school management, the challenge is to balance the investment in ICT infrastructure with ICT training for teachers to ensure that teachers know how to use the ICT resources.

4.2.2.2 ICT Training

To the teachers' credit, many of the technical issues are resolved by the teachers themselves. H3 cited the approach most Cool School teachers take when encountering ICT problems in the classroom.

'We have to solve the problem ourselves, for the first 5 to 10 min…sometimes, he [technical staff] is really very busy, [with] everyone calling him here.' [H3]

However, when the teachers are really unable to solve the problems faced such as the use of wireless connections to access internet, employment of Flash software to create animation, downloading and converting video clips into another format, and the adoption of SmartBoard for teaching, they turn to their colleagues or the technical staff for help. The patterns of these interactions concerning ICT are discussed in the section under Collegiality (SRQ 4). At this point, it is sufficient to note that the expertise described above concerns higher-order ICT skills compared to the typical PowerPoint presentations and showing of video clips which the teachers in Cool School are able to handle.

'…in general, not everyone is IT savvy, sometimes we meet a lot of difficulties like downloading videos, how to convert the video into a more friendly kind of clip .'[S1]

There does not seem to be any formal ICT training so far although most teachers feel that it will benefit them if there is some form of 'strategised' training. L1 mentioned that proficiency through training will increase teachers' confidence levels in ICT use:

'[Workshops needed would be] strategised learning workshops where teachers learn to use the machines more than listening to someone how to use them…Teachers will implement more ICT lessons in class if they are proficient because it takes confidence.' [L1]

Echoing the same call for ICT training for teachers, T1 believed that confidence building through training will result in more teachers using ICT. His quotation is as follows:

'…this [training] will help the teachers to be more confident and once they are more confident, the teachers are more willing to use ICT...' [T1]

However, in the absence of formal ICT or pedagogy training, many teachers are taking a proactive approach to learn from their colleagues or to self-train 'on the job'. Hence, a lot of training is hands-on and 'just-in-time' for application to teaching in class.

'Even when I was in JC or University or work, it was a learn-on-the-job thing. It is more hands-on. No, I don't do any courses…if people are friendly, I will ask. [laughs].' [S3]

Teachers, such as L1 and S3, indicated that learning software application is essential for their professional development. However, pitching the training at the right level for immediate application in the classroom for these already ICT-competent teachers can be difficult. Hence, the surprising answer is that sharing among teachers and on-the-job training may actually be more effective as these approaches ensure the instruction is pitched at the right level and structured for real-time application. The teachers also highlighted the need to address teaching methodology and this will be addressed in the later section on pedagogical support.

4.2.3 Summary

In summary, the teachers exhibit excellent skills at using ICT for their personal networking or communication purposes. They are able to access social networking sites (e.g. FaceBook), use emails, publish blogs and view YouTube video clips. These personal ICT skills spill over to the teaching domain as teachers utilise the same tools for teaching.

The teachers at Cool School appear to rely mostly on themselves to operate ICT for teaching. They approach other teachers for technical assistance if necessary and, as the last resort, the technical officer. Due to the lack of some ICT equipment and facilities, there are constraints as to what teachers can do to make the lessons more ICT-enabled. As a result, many teachers turn to ICT resources which are new, cheap

or free such as blogs, YouTube video clips, FaceBook social networking platforms, Skype video-conferencing software and online quiz portals, which are familiar to both students and teachers. More importantly, because these resources are freely available, they provide the space for teachers to be innovative and resourceful with little risk or pressure.

Using the Hypertext Model as a reference, Cool School teachers are likely do very well on the Facility dimension, given their ability to handle different types of ICT both on the personal and professional levels. With many of the teachers being young and ICT-savvy, they take to ICT naturally, although a few teachers (e.g. S3 and L1) expressed uneasiness at using ICT to teach initially. The challenge is for teachers to constantly keep abreast of the technological developments, in order to take advantage of them. Technical skills are also lacking especially when it comes to operating the ICT equipment when they fail.

Section 4.3 Use of ICT for Within and Cross-Disciplinary Instruction

This section will examine the findings in relation to the process by which teachers adopt and utilise technology (often 'cheap' technology) in their teaching. It will address the following SRQ:

SRQ3: **How do teachers and school leaders view the link between technology and teaching?**

Firstly, the manner of ICT implementation can be further examined according to within-discipline and cross-discipline perspectives, in line with the two layers in Schussler et al. (2007)'s Hypertext Model:

4.3.1 Transparency (how technology is used for within-discipline teaching)
4.3.2 Connectivity (how technology facilitates cross-disciplinary teaching)

Secondly, it is important to determine the point at which teachers and school management leverage on ICT to exert the maximum impact on learning and school results. The earlier sections have established that the teachers use ICT in different

ways (to motivate students, present information, facilitate student collaborations and student research as well as for interactive student learning).

4.3.1 Transparency

This section will examine how these modes of ICT use coincide with the teachers' choice of technology to bring about effective within and cross-discipline learning. The findings of this section are crucial to the whole dissertation as the process of ICT implementation is examined in greater detail. The reasons behind how the teachers implement ICT are also examined in relation to their beliefs concerning learning efficiency and school results. In other words, what do the teachers really believe in concerning the use of ICT for learning and teaching and what do they do about their belief?

Beginning with the end in mind, teachers are often held accountable for their students' examination results and it is appropriate to determine if teachers perceive ICT as beneficial to helping their students achieve better grades. Based on the interviews with the teachers, there appears to be a mix of different perspectives. A few teachers (H3, S1 and S2) believe ICT contributes to the learning process, thereby contributing to better results, albeit indirectly. H3, a humanities teacher, attributes her students' better performance indirectly to ICT use in class.

'I perceive ICT helped in the learning of [Cool School] students in general thus indirectly helping with the examination results.' [H3]

The point to note here, however, is that, according to H3, ICT is *only* an indirect contributor to the students' better grades. In contrast, H2 perceives the impact of ICT on examination grades to be relatively minimal, primarily due to the fact that ICT in Cool School is still at the pubescent stage. Her perception is that ICT use can be further developed, from presentation-based ICT such as video clips and PowerPoint slides to a more interactive ICT use. H2 attributes the students' results to the teachers' support and encouragement to the students rather than to ICT use directly.

'I would not attribute the success in examination results to ICT…Much of our teaching is still based on PowerPoint, videos, chalk and talk, hands-on demonstration. It's still largely based on the interpersonal relationship that the students have with the teachers, one-to-one remedial that helps the students.' [H2]

In this regard, the assumption behind H2's perception is that the use of ICT as a presentation tool is not as effective as the teacher's one-to-one remedial sessions with students. Her pedagogical belief seems to be slanted towards constructivism, where learning occurs (or is constructed) through the learners interacting with the environment and with others. In this regard, non-interactive activities such as video clips and PowerPoint presentations are perceived as less effective learning methods and would need to be supplemented with more constructivist, activity-based approaches such as discussions, interactive learning games and role plays, for example (Harasim *et al.,* 1995).

As expected, H2, in her response, seems to allude to the use of ICT beyond presentations and teacher demonstrations. To H2, visual presentations are just not good enough to be considered really 'ICT use'. For teachers who share similar perceptions as H2, student engagement in a highly interactive manner is the key to effective learning. Students do not need to just sit in their chairs to watch but they can participate in the learning with others.

'I seriously don't think the using of PowerPoint is considered ICT…ICT is more than PowerPoint and Flash…To me, showing video [or PPT slides] is a very visual thing…it will become one-way teaching. It is very passive learning.' [H2]

According to H2, the correct approach to using ICT to increase interactivity is to ensure that a 2-way communication between students and the materials must take place. It should not just be a 1-way download of information by students using ICT.

'ICT means I can get the students to do something online…must be a two-way ICT communication - tablet to tablet, computer to computer.' [H2]

H2 further qualified what she meant by two-way communication with her use of FaceBook to encourage voicing of opinions and in doing so, providing a platform to stimulate thinking of the issues. This rides on the interpersonal relationship that the teachers have with the students, a strength in Cool School where teachers take time to build strong relationships with their students.

'…I created a FaceBook group because I want to force them to voice their ideas.' [H2]

Hence, H2's definition of two-way communication is to use ICT as a medium for communication, from computer to computer with the students and teachers at the other end of the communication line. It appears that in her quest to move away from 'passive learning', H2 has employed other students to provide the interactivity in the learning process. Through FaceBook, the students can comment on each other's opinions and correct errors. It is also a social media resource that they can identify with. H2 made it clear in her quotation that social media can encourage interaction:

'…students that seem quite quiet and uninterested in class or disengaged but when they are in the Facebook group, they actually 'talk'…there is probably safety in virtual reality.' [H2]

In addition, H2 used the group FaceBook as a repository of materials she used in class so that the students can revise by going back to the repository for reference.

'I convert my PowerPoint slides and teaching materials into videos which I paste onto Facebook in the group itself so when they need to do revision, there is some digital footprint for them to follow.' [H2]

Following a relatively successful trial at using FaceBook to engage learners, H2 and the Humanities Department have utilised blogs as an interface for online submissions and discussions.

'I get the students to do online assignments, discussion board online but it is structured supervision. I post a topic…They will write what they think so I will assess them based on their thoughts.' [H2]

[Deleted screenshot of blog]

Figure 4.4. A Screenshot of the Blog Website for Students to Work on Their Humanities Assignments

By taking the discussions online, students continue their learning beyond the classroom, into their own homes at night. In this way, the students are engaged and with a more relaxed setting, they can reflect on the topic more thoroughly. For many of these students, the online environment may appear safer and they can take their time to think through the issues before they respond. In the same vein, using online quizzes to engage learners is the other natural development which evolved over time for Cool School. These quizzes provide the students with their scores at the end of the completion of the quiz. With no limit to the number of times the students can attempt the quiz, they can keep on trying without the fear of their classmates belittling them. In many cases, these software are provided free online; another example of cheap technology being used by Cool School teachers to good effect.

'…students do the online quiz many times until they pass. They submit assignment online through this particular…free (software).' [H2]

To summarise, the examples of technology along with the nature of the pedagogy used by H2 in her lessons or engagement with the students include:

	Hardware and Software (Technology)	Examples	Instructional method (Pedagogy)
1	PowerPoint slides / software / Projector	Presentation on topic Teacher demonstration	Lecture or didactic delivery
2	Video clip / projector	Showing a YouTube or movie clip	Didactic delivery
3	FaceBook / computer / Internet connection	Posting topics on FaceBook and asking for comments	Socio-interactive approach Critical reflection
4	FaceBook / computer / Internet connection	Placing resources and materials in FaceBook for student reference	Self-directed learning
5	Blogs / blogsite / computer / Internet connection	Posting questions for assignments online and students to submit their comments or assignments via portal	Socio-interactive approach
6	Online quizzes / quiz generation software / website / computer / internet connection	Generating a quiz for students to attempt	Constructivist approach Production-based

Table 4.2. The technology and the accompanying pedagogical beliefs demonstrated by H2

Table 4.2 allows further examination of how the use of ICT is coupled with certain pedagogical practices and beliefs. In H2's case, she opted to use the more constructivist approaches such as online quizzes and social networking platforms like FaceBook in her work to engage the students. Having said that, this does not preclude the fact that H2 also used video clips and PowerPoint slides to teach but

apparently, she preferred to use the constructivist approaches to supplement her presentations.

More importantly, the coupling of the technology with the accompanying pedagogy illustrated in the table also suggests that it is not possible to only examine the choice of technology by teachers without also reviewing the teacher's pedagogical beliefs and practices. At this point, it is unclear how a teacher's choice of technology is determined by his or her pedagogy belief and vice versa. However, what is clear is the need to take a holistic perspective to the issue of technology adoption, beyond just the ability of the teachers to manage the technology as a determinant of technology implementation. It will also be useful to examine if teachers other than H2 also demonstrated similar pedagogical beliefs in deciding which technology to adopt.

L1, an English Language teacher, indicated her reluctance at using ICT in class, especially ICT such as PowerPoint presentations or video clips for her lessons. Her rationale is that there are other options available and ICT may not be the most effective one.

'[I am not motivated to use ICT in class] because there are so many options that we have not researched yet. ICT is only one of them… I'm not doing [ICT lessons] that often because I get a lot more out of being away from the computer.' [L1]

Her response above was given during the first phase of the study. Subsequently, when she was interviewed in the second phase six to eight months later, she showed interest in using blogs for students to record their responses to videos clips or articles. The following image (Figure 4.5) shows an entry by her on how she caught on to the idea of using blogs to teach English from her student.

[Deleted Screenshot of Blog]

Figure 4.5. A Screenshot of a Blog with YouTube video clips for Writing Assignments

Her interest resulted in a departmental project for students to view topics posted by teachers and for them to submit their assignments. See Figure 4.6.

'For junior projects like Podcasts…you can check out englishcafe.wordpress.com.' [L1]

[Deleted Screenshot of website]

Figure 4.6. A Screenshot of the English Café Website for Students to Work on Their English Assignments

More tellingly, her enthusiasm about using blogs for teaching led her to email the Principal on the effectiveness of the blog in teaching English. The Principal then emailed the Vice-Principal to follow up on her idea. Below is a quotation from the Principal concerning L1's contrasting change in attitude and behaviour from a reluctant ICT user to one championing its use in Cool School.

'The other day, [L1] sent an email to everyone to say, "Oh, I realize that it is quite useful for me to store my ideas on a blog so that's my way of documentation."' [P]

L1 moved from a non-user to an advocate of ICT use. What was the reason for the transformation? Her belief in designing lessons which engage learners hasn't changed. What changed is the availability of technology that allows interactivity among students and teachers. Hence, when she became aware of the technology (blogsites) which allowed for discussions and commenting, her adoption of ICT changed from practically non-existent to high. With ICT presentational tools, L1 was not interested as it conflicted with her belief in how lessons ought to be conducted. With ICT as a collaboration tool, L1 embraced the technology and even championed it among her colleagues. To the teachers in Cool School, L1's change in perception towards ICT is a powerful demonstration how a teacher's pedagogical belief (which is essentially socio-constructivism) can drive the ICT adoption process. As such, perceiving ICT as a uniform, homogenous pool of electronic resources for teaching is a mistake.

The examples (H2 and L1) illustrate that pedagogical beliefs can affect one's influence on one's choice of technology to use in the classroom. What is less clear is whether the reverse is also true. Will the type of technology available in the school also impact a teacher's pedagogical practice?

In Cool School, the advocate for SmartBoard use is S3. This is evident from her responses during the interview as the use of SmartBoard was highlighted throughout the interview. Some of her responses are reflected below. S3 stated:

'When...you teach using that [SmartBoard],…it is like you are painting a story. You also feel energetic… so it motivates you to try different things.' [S3]

In the quotation above, S3 made the point that the SmartBoard motivated her to try different things. This is an important observation as it shows, at least in the case of S3, technology type can influence what the teacher does in class. To what extent 'different things' implies different pedagogical practice is unclear. However, S3 did mention different attempts at using the SmartBoard, some of which worked better than others. Getting the students to go up to the SmartBoard to move the displayed items on the touch-sensitive board was highlighted but according to S3, it did not work well due to the shyness of the students.

'…usually I don't have much chance to ask them to go to the front [to use the SmartBoard…they just freeze up when I get them to come up to do…' [S3]

S3 had more success in the use of SmartBoard as a presentational tool. Its strength in visually illustrating the changes to the chemical bonds in organic compounds was well utilised. The transitions were impressive and effective. S3 continued on the impact of SmartBoard for presentations:

'I [used to] make cards with magnets behind so that I can move them to show the change but when I use the SmartBoard, …I can draw the entire alkane group [on the board]…then you will hear 'wow, wow'… you can move [images] from there to here…Because of the movement, it looks 3-dimensional. It captivates the attention of the students... It brings the information to life.' [S3]

Whether the initial failed attempt at getting students to do something different such as going to the SmartBoard to work with the images resulted in S3 being disillusioned with the constructivist approach or whether her belief in clear and effective didactic teaching drove her to adopt a presentational style of teaching is debatable. It may be a case of S3 already possessing the tendency to conduct didactic instruction and the failed attempt simply reinforced her belief that constructivist approaches do not work, especially for her students who need a more structured and guided method of teaching.

This is shown in her response when asked if her approach to using ICT should be teacher-centred or student-centred. S3 responded that a mix of both is necessary due to the profile of the students in Cool School. She felt that the students need the structure that teacher-centred approach can provide. Too much student-centred learning may confuse the students further.

'It should be both [teacher-centred and student-centred]…If it [teacher-centred] means just chalk and talk, then it is not [my approach]. Student-centred…could be [effective]…[but] I think our students are not ready.' [S3]

To what extent students need to be ready for constructivism is also questionable but S3's viewpoint about maintaining a balance between student and teacher-centred approaches ought to be respected. After all, teachers generally know their students better than many others outside of the classroom. S3 went on to add that she usually presents for a maximum of only 15 minutes, followed by individual work by the students. This ensures student concentration.

'When I teach one concept, it only takes me 15 min to teach them, the rest of the time they do it by themselves. Because they have their whiteboard, they can work on it...That will balance it out. I notice that when they do things by themselves, their concentration is spread out.' [S3]

Hence, it is unclear if S3 already possessed a tendency towards didactic teaching which primed her to adopt the SmartBoard as her presentational tool or if the SmartBoard provided her with an excellent and effective presentational tool which changed her pedagogical belief about the efficacy of didactic teaching. What is clear is that decoupling of pedagogical beliefs from the type of technology is not helpful. From S3's case, it is obvious that S3 chose the SmartBoard because it is a highly effective presentational tool. She could follow up with an individual production-based activity which addresses the student's need for hands-on outputs. Some teachers do not prefer a presentational approach to teaching (even for the initial teaching of the concepts) and they have declined the offer for a SmartBoard in their classroom.

'Some teachers will tell you "I don't want a SmartBoard" but that is their style.' [S3]

Compared with H2 and L1, S3 demonstrates a different approach to using ICT. When coupled with her tendency for didactic instruction, the use of the SmartBoard as a presentational tool is used to good effect. H2 and L1, on the other hand, adopt ICT for collaborations and completion of online quizzes, which are inherently more interactive in nature. Similarly, while S3 adopts a didactic delivery approach when using ICT to teach, it does *not* mean that she does not use constructivist teaching approaches when she is not using ICT to teach. She may still adopt group discussions or peer teaching methods *outside* of the ICT-enabled segment. This is an important distinction to make as teachers should not be typed according to how

they use ICT but more so, how the technology lends itself better to certain delivery approaches. The teacher's pedagogical beliefs may influence his or her decision to use the ICT in a certain way but it does not mean the whole lesson will turn out that way. The teacher can still switch to a different approach of teaching before or after the ICT-enabled segment. For example, L3 mentioned how she would use discussions to reinforce the concepts taught through the presentations.

'I could have journaling or speech orientated activities – talking, discussion, debates to reinforce the learning from the video clips.' [L3]

A review of other teachers do with ICT showed a few other examples which differ slightly from the three teachers described above. For example, S1 presented a video clip to the class to stimulate interest in the topic in contrast to showing video clips to present information.

'The ideal lesson is to start off with an inspiring and motivational clip and after that weave it into your lesson… If I'm teaching kinetics, I will show them a clip about someone paragliding or the latest moving plane.' [S1]

When there is a lack of suitable video clips, some teachers (e.g. M2 and M3) have resorted to making their own video clips (on using laboratory equipment) to present the information to their students.

'We do videos and post it on YouTube once… M3 did the video taping, just the hands only. It wasn't very well-done. S3 did switching on the Bunsen burner…That one was more professionally done.' [M2]

By using ICT, teachers have more options to work with when delivering information to their students. Among the various ICT-mediated activities listed above, there is a notable absentee – the use of ICT for hands-on interactive learning.

'I think interactive software - that would be best. In fact I was always hoping we can come up with our own storyboard to teach.' [S1]

The difficulty that teachers face in coming up with interactive learning software, results from the lack of time, resources and expertise in designing such software. In the case of S1, despite her desire to design her own interactive software customised to the needs of her students, it remains a dream. The lack of appropriate software and to some extent, presentational materials (e.g. suitable video clips) points to the difficulties teachers faced in using ICT for effective instruction in class. Improvisation of ready-made materials is only effective up to a certain stage and self-made materials (e.g. video clips of lighting a Bunsen burner) are tedious to produce and are specific to particular lessons and subjects. Sourcing for appropriate ICT materials seems to be an important area of need for Cool School teachers, especially if 'cheap technology' is used.

With these additional examples of how teachers are using ICT to make their lessons more effective, Table 4.3 which illustrates H2's use of ICT can be updated to include the other examples cited above.

	Hardware and Software (Technology)	**Examples**	**Instructional method (Pedagogy)**
1	PowerPoint slides / software / projector	Present topic Demonstrate concept ICT Email slides to students for revision	Lecture or didactic delivery
2	Video clip / projector	Motivate students using video clip Present information (can be a teacher-made video clip) Revise concepts	Didactic delivery
3	SmartBoard / projector	Present information with 3-D transitions	Didactic delivery
4	FaceBook / personal computer / Internet connection	Place resources and materials in FaceBook for student reference	Self-directed learning
5	FaceBook / personal	Post topics on FaceBook and	Socio-interactive

	computer / Internet connection	ask for comments Provide learning guidance Provide Advice	approach Critical reflection
6	Online quizzes / quiz generation software / personal computer / internet connection	Generate a quiz for students to attempt	Production-based
7	Blogs / personal computer / Internet connection	Post questions for assignments online and students submit their assignments via portal	Socio-interactive approach
8	Websites, blogs, forums and CDs	Assign students to conduct research online either from websites or other experts	Socio-interactive approach
9	Interactive software for learning	Provide learning activity either online or CD for students to engage in	Constructivist Production-based

Table 4.3 Linking ICT Use with Pedagogy

Table 4.3 illustrates the range of ICT activities that teachers in Cool School utilise when teaching their students and the pedagogical skills required. The pedagogical shift from didactic use of ICT to a more socio-constructivist utility as one moves from one ICT type (e.g. LCD projectors) to another (e.g. blogsites and portals) is clear based on the table above.

4.3.2 Link Between Technology Type and Pedagogy

Notably, certain types of ICT (such as projector, PowerPoint slides and video clips) lends themselves better to motivational and presentational functions due to the lack of interactivity provided. The Principal emphasised the importance of applying the right pedagogical strategies when using specific ICT (e.g. PowerPoint slides):

'If [the teachers is] using PowerPoint [slides] fully 'clumped' with words [and it] doesn't help the teacher to communicate, then the teacher shouldn't have used [it], [he] shouldn't use [ICT] for the sake of using…one of my university lecturers who is very popular in Economics [used] the OHP but his 'slide' was different from other

people's slides because he drew on them... Using the slides, he was able to communicate his thought process of drawing a graph.. but another lecturer may have the entire diagram in the PowerPoint, a finished product … but what he failed to communicate is how do you get there? What is the thought process?' [P]

Compared to the teachers in Slay *et al.* (2008)'s study, the teachers in Cool School seemed to have adopted the Interactive Whiteboard relatively well by exploiting it as a highly visual teaching tool with transitions being a key draw rather than attempt to have students interact with it.

Conversely, for teachers to adopt ICT for collaborations and interactive learning, students need to have their own ICT devices in order to respond in a tactual or kinaesthetic manner (e.g. personal computers, iPods, mobile phones). Cool School teachers overcome the limitations by getting students to access the internet at home using their own computers. Social networking sites such as FaceBook and blog sites and forums are used as platforms for discussions and collaborations. Teachers such as L1 have used ICT in this manner in a highly successful manner.

The real difficulty that teachers face, however, is the lack of appropriate cheap interactive learning software. The fact that no teachers could cite an example of interactive learning despite being asked to is testimony of this difficulty. The difficulty stems from the needs to customise the resources (e.g. an interactive game) to the specific topic being covered and it cannot be based on a syllabus used in Europe or America. It has to be contextualised to the Singapore context. As a result, Cool School teachers have to design and possibly programme the software themselves if they want interactive learning using ICT. With budget, time and expertise constraints, it is almost impossible to overcome these difficulties despite teachers having the desire to use ICT for interactive learning.

'…[If] we don't have hands-on [ICT] to let them feel, touch, they will not find learning interesting.' [M3]

Other issues associated with ICT use include plagiarism and ICT-enabled projects being too time-consuming. L3 cited examples of how students plagiarise materials from other websites as part of their teaching assignment:

'We have this plan where we let students be teachers for literature. I find it not quite helpful because they plagiarize a lot…for about a semester.' [L3]

On the other hand, getting students to produce their own videos resulted in highly time-consuming projects which the teachers and students could not manage. The production-based exercise was cited by H2 as unmanageable:

'There was 1 year I got them to do video production but that really took up a lot of work and I didn't know how to do it…a few years back…it is just too much work that we cannot handle.' [H2]

4.3.3 Connectivity

From *Transparency* which involves how teachers utilize ICT in their lessons, Schussler et al. (2007)'s Hypertext Model next lists the factor of *Connectivity* (how technology can facilitate cross-disciplinary teaching). From the data gathered, there were very few examples of such cross-disciplinary teaching in Cool School due to the focus on preparing students for the O Levels examinations.

T1 highlighted one exception of a Chemistry lesson where making connections explicit between isotopes (Chemistry) and forensic science (the larger context) can help students see the relevance of the topic.

'Students have never understood why they study isotopes, right? But now,…we can actually link forensic science and isotope together...you can actually detect from the crime scene where people…have stepped on because the soil at location A is different from the soil at location B…Putting it on the SmartBoard, it is more interesting than following a theory.' [T1]

To a large extent, the introduction of contexts is part of the teacher's desire to cultivate the students' interest in the subject. The motivational purpose is relatively clear in this example. It is also arguable if the example is truly inter-disciplinary as Chemistry is likely to be located within forensic science and so they are not entirely different disciplines altogether. In Cool School, students who undergo the 2-year programme are required to complete interdisciplinary projects using ICT. Students use ICT to conduct research and to present their findings and in the midst of doing so, acquire ICT skills.

'Those [students] who [spend] 2 years with us…have projects to do - mini projects, so they have to source for information, the evidence and the history of the topic they are doing…integrated, interdisciplinary…' [M3]

Often, these students use ICT at much higher levels of competence which may not be taught in school. For example, some students acquire skills in conducting research online and using Photoshop (software for editing photos) through the inter-disciplinary project (e.g. Chemistry with Mathematics). S2 gave further details on the project:

'…some are quite amazing like last year…for Chemistry, … [they used] Photoshop, PowerPoint… impressed me.' [S2]

However, the teachers are clear that their key objective is to help the students get the necessary grades for their O Levels examinations so that they can move on to further education in their academic life. Many of these students are school drop-outs from mainstream education and so they are depending on their current teachers to help them get back on track. While cross-disciplinary education is pedagogically sound and useful for building links across topics, for these students, getting familiar with the key concepts within the individual subjects is already a challenge so it is understandable that teachers do not always focus on teaching beyond the syllabus.

It is also noted that 'Connectivity' tends to illustrate similar pedagogical practices as 'Transparency', partly because both dimensions comprise how teachers incorporate ICT into their teaching, whether within the discipline or across disciplines. Hence,

there is a significant amount of overlap between the two dimensions and may not be as useful in helping schools understand key capacities concerning ICT use among teachers. Furthermore, with examinations being a key driver of teaching practices, it is rare that teachers teach across disciplines, much less use ICT to enforce cross-discipline learning. To a large extent, 'Connectivity' is not useful and applicable to Cool School.

4.3.4 Management's Perceptions on Technology and Teaching

In general, the school management expect teachers to think through how ICT and other teaching strategies should be utilised. Clearly, using ICT should not be the final objective. The Principal emphasised that ICT is only a tool and every lesson should be evaluated in terms of how it helps the students learn better. He added:

'…it doesn't mean that every teacher needs to use IT device in every lesson that they do... doesn't mean for everything you need to have a video...it is a tool.' [P]

The Principal also highlighted the importance of the teacher's role in the classroom. Ultimately, the teacher needs to engage by being relevant and through good communication skills. He explained:

'I think the core of it is that the teacher needs to know that their primary job is to be a communicator, so every new product…is supposed to enhance the mode of communication. It is not supposed to replace [the teacher]. If using a PowerPoint full of words doesn't help the teacher to communicate, then the teacher shouldn't use [it] for the sake of using.' [P]

The VP is also clear concerning the right pedagogical practice when using ICT so that it can effectively engage the students. On which part of the lesson that ICT can be used, he gave examples:

'Beginning and middle...beginning because it helps to capture the attention…middle because if you trace attention span for the student, it is the lowest, you better inject something.' [VP]

Commenting on the current stage of ICT innovation in Cool School, the VP emphasised that they are still at the initial stage of working through the types of ICT to be used. Commenting on their philosophy to share their work with other schools to benefit each other, he mentioned:

'[Still at] the beginning phase...Starting to put up videos [online]. Chemistry put up videos on YouTube, English put up assignments on Wordpress. It is all very…public sites and the intent is not to patent it but to share ideas.' [VP]

With the clear mandate from management on using ICT in a sensible and learner-centric manner, teachers enjoy the autonomy to experiment with different ICT strategies and this is seen from the number of different initiatives teachers from the various departments have attempted in the short span of 3 to 4 years since the availability of online resources for learning purposes.

4.3.5 Summary

The general ICT approach is technology-driven where the teacher picks out the relevant technology (equipment or resource) and attempts to fit into the lesson. Teachers typically do not demarcate their lessons into segments of teaching and learning so clearly. The phases of learning, processing and production involve a natural flow of cognitive and social processes for learning and internalisation of concepts to take place (Choy, 2009; Witkin, 1984). This learning and production cycle is clearly captured in the quotation by S2's quotation.

'…when you start this video, you can capture their attention. That's the time you can download [or present] all the information, then you will lose them [the students] again. Then you can give them worksheets to do.' [S2]

There are two considerations teachers have to bear in mind when planning lessons:

- student-centred or teacher-centred approach
- ICT and non-ICT use

These considerations result in four options (see Table 4.4.):

Student-Centred With ICT	**Teacher-Centred With ICT**
Student-Centred Without ICT	**Teacher-Centred Without ICT**

Table 4.4. Four Options to Using Student and Teacher-Centred Approaches along with ICT Use or 'Traditional – Non-ICT Use'

There are advantages and disadvantages to each of the four options. The teachers appear to favour a pragmatic approach with the majority emphasising strategies that match the learning needs of the students. By focusing on the students, H2 emphasises the need to understand and engage the students through the teaching and ICT does that for the teacher:

'By comparison, your learning [in school] is not as colourful or exciting as what you experienced in the outside world. Then why would you want to come to school?...So how does ICT fit into the whole pedagogical framework?…The world out there is very ICT-[based]. The kids out there are very ICT-[savvy]. Therefore you need to be ICT-[competent]. It really is a contest of influence.' [H2]

Unsurprisingly, these perceptions of ICT being a tool of influence on the students drive a number of Cool School teachers (M3, M2, S3, H2, VP, P) to adopt ICT tools such as video clips to start the lesson in a captivating manner. Some teachers use the common slideshow and video clips to provide visual inputs. These strategies will place the teaching in the 'Teacher-centred with ICT' category. There are, however, some teachers who adopt ICT for production-based activities such as student PowerPoint presentations and online quizzes, primarily a 'Student-centred with ICT' category. This category has another sub-category which involves using ICT for interactive learning and this is one strategy that is rarely mentioned by teachers in the interviews due to resource constraints.

It appears that most Cool Teachers understand what works best for their students – whether a student-centred or a balance of teacher-/student-centred approaches. The use of ICT to bring about more learning activities in class seems to provide an additional avenue for teachers.

There is evidence from the 'failed ICT experiments' that the teachers are utilising ICT in a measured manner to contain possible risks and to ensure that the results are mostly positive. These examples of 'failed' ICT experiments such as getting students to film their own video clips indicate that teachers are quick to realise the ICT-based experiments are not working and to either modify or abandon the initiative. This culture of allowing teachers to try is an important one and will be further discussed as part of the school's organisational culture of allowing ICT initiatives to grow and die organically.

More importantly, the support from the teachers and management was tangible and substantial to ensure that teachers continue trying despite failing at getting some of the initiatives off the ground. The next section will examine the ICT collaborations among teachers to support the more effective ICT initiatives.

Section 4.4 Collegiality

The previous three sections examined the school management and the teachers' responses in relation to the first three SRQs. The examination of the data was also extended to include the evidence for the four dimensions in Schussler et al. (2007)'s model:

- Familiarity (of pedagogy and students' needs)
- Facility (or technology)
- Transparency (using ICT to teach curriculum)
- Connectivity (using ICT to facilitate cross-disciplinary learning)

In Section 4.4, the data concern how the teachers collaborate with each other and with the management to implement ICT initiatives, in particular addressing SRQ4.

SRQ 4: How do the management and teachers collaborate to implement ICT initiatives in the school?

Sections 4.4 and 4.5 will also continue to examine the last factor in the Hypertext model concerning Collegiality (ICT support from peers and technical staff, and professional development).

Besides teachers' responses from the interviews, the results are also based on teachers' verbal and written reports through a qualitative survey on interactional patterns with each other.

The responses shown in the earlier sections are indicative of a close-knit teaching community with teachers citing work done by other departments and knowledge of ICT projects spearheaded by different departments. The responses from the teachers listed below are categorised according to:

- Collaborations among teachers
- Technical support
- Interactional patterns

4.4.1 Collaborations among Teachers

The modes through which teachers collaborate in Cool School are through informal channels such as face-to-face coffee chats and emails and through formal channels such as school meetings, project meetings and uploading of slides into the shared network. What stands out in Cool School is the willingness to work together and share on an informal basis among teachers. For example, M2 elaborated on the wide range of the ICT resources that teachers share with each other:

'We share slides among our own faculty. We put it up on the network and anyone can open it. When we find useful websites, we alert each other, even like the YouTube thing, those filming [of instructional videos]… so most of the time we have discussions.' [M2]

M2 mentioned the filming of instructional videos to teach Mathematics concepts (for example, the use of the scientific calculator) which several teachers collaborated to produce. Correspondingly, the Science department also collaborated to produce video clips for podcast on how to operate the Bunsen burner.

'Science (Department) did the podcast and everybody knows about it. So we know that this is something we can explore, share by emails. If there is something that is not the ordinary, we will share it. [As for] CDs, we do show videos once in a while, but it's quite tough to get a Mathematics video.' [M2]

Interestingly, the comment on the Science podcast project was made by M2, a Mathematics teacher, which illustrated the widespread knowledge among the teachers (across departmental boundaries) concerning the ICT projects being implemented in Cool School. However, most of the collaborations cited tended to be sharing of resources (such as slides and websites) more than actual collaborations among teachers as H2 commented:

'Recently, they [teachers] found a website with very good PowerPoint games. It is quite interesting… Usually we share with everybody. We sent them (an) email and said [that] this is the place you can go…the students liked it as a game.' [H2]

In addition, when asked about the frequency of these email and informal sharing interactions, S1 mentioned that they occur on a fortnightly basis while H3 did not think it was very frequent:

'When we find something very good, then it just goes around. It's very informal, spontaneous. Actually no frequency…quite hard to gauge but I would say once in 2 weeks.' [S1]

'Not really, we just share whenever we find new things. Not really frequent.' [H3]

The collaborations that teachers undertake in Cool School also centred round departmental projects such as the Science podcast video clips and the Mathematics

video clips mentioned earlier. S2 talked about how sharing took place generally within the department rather than across departments:

'We do share a good clip, a relevant clip like the humanities department, oh this clip related to physics, science, then they will send to us…Informal...Inter department not so [often], but within the department quite [often].' [S2]

It is also because of these observations that the second phase of study was launched to investigate the pattern of the collaborations that took place in Cool School and how the teachers supported each other in conducting ICT lessons.

More importantly, besides the sharing of resources, teachers also pool together their ICT-related skills and knowledge. S3 specifically mentioned the pedagogical skills associated with the use of specific ICT resources:

'…sharing of skills on how to use that… like how you use the slides and if they know some things and they have been using it in different manner because you can't figure the whole thing out for yourself.' [S3]

This type of sharing is significant as it goes beyond resource sharing into capability building of fellow teachers. The fact that the teachers are willing to share pedagogical skills in the use of ICT also points to the fact that some pedagogical skills can be specific to the ICT being shared. In the quotation above, S3 highlighted that teachers can use the slides in different ways. It also implies that the various ICT resources may require teachers to adopt different pedagogical skills to maximise its impact on learning and teaching.

Besides having to equip themselves with specific pedagogical skills which can be ICT-specific, teachers also find themselves requiring technical skills to operate or problem-solve ICT equipment. The technical support from the facility officers and colleagues can be very useful.

4.4.2 Technical Support from the Support Staff and Colleagues

The amount and type of technical support needed is indicative of the level of ICT competence teachers have in general. To some extent, teachers in Cool School tend to be self-reliant although the availability of technical support from the Technical and Facility Officers is as much a psychological as a practical aid when needed. S3 explained:

'[The Technical Officer] helps with the IT. Most of the time, it is because we don't know how to fix it properly. It is either you change the connection [or] most of the time, [when] we do not know how to use it, he does help. [But if] everybody calls his name, he also gets frustrated.' [S3]

Being understanding, class teachers may switch to activities which do not utilise ICT when ICT equipment breaks down. M2 cited her response to equipment failure which also illustrated her flexibility in utilising both ICT-enabled and non-ICT-enabled activities for her lessons.

'We do have a …[Technical Officer] who comes to help. If not, we just have to break away and do practice [exercises] first. If not, we have to fix [it] ourselves, get a spare projector and stuff like that.' [M2]

The extent of self-reliance is reflected in other teachers mentioning their ability to cope with ICT issues. Below is M3's response to ICT problems:

'I think [T1-the Technical Officer] will [help with] the network problem, the wireless problem I don't know how to do. Basically apart from that I'm quite self sufficient.' [M3]

In line with what Zander (2004) found, teachers without dedicated technical support become more ICT-competent over time. Eventually, the need for technical support diminishes due to the increasing competence of teachers in solving their own ICT problems or those of their colleagues and this self-empowerment develops confidence in the teachers to adopt ICT practices over time. The limited technical support, in hindsight, may be useful for capability development among teachers as a group. When necessary, the teachers ask their ICT-savvy colleagues and even the

students for help. M3 shared about her experience at helping her colleagues at trouble-shooting ICT issues:

'They term me as IT mama. It seems that things that they cannot solve, I know. Sometimes when they cannot print a certain page they ask why, or when they ask about wireless connection… [at a frequency of] 3 out of 5 days.' [M3]

L3 is one of the teachers who would ask M3 for help, besides asking her students when needed:

'[I get] a lot of support like if I have any queries on how to download any videos from any site. If I don't know, my colleagues will be very happy to help me do it – [T1], [M3] and also I think there's always some tech savvy kid in the class.' [L3]

The data indicate that the technical support seems to be broad-based with several sources of help available, ranging from the technical and facility officers (although officially, they are not in charge of ICT but equipment and the school facility in general), fellow teachers and even students. More importantly, because there is no ICT department, teachers learn to be self-reliant and open to helping each other solve ICT-related problems. The ownership for solving these problems appears to be shared among the teachers and students. However, there seems to be a pattern as to who the teachers go to for help. For example, L3 will go to T1 or M3. Who do teachers collaborate with? Does the sharing of expertise occur within or across departments?

4.4.3 Interaction Patterns among Teachers

A socio-gram (see Figure 4.7) was mapped out based on teachers' responses on who they work with when collaborating on ICT projects or when they need help. The arrows in the socio-gram start from the initiator of the interaction to the recipient. The colour tone of the arrow represents the frequency of interactions. The darker the colour of the arrow, the more frequent the interactions are. In the socio-gram, purple arrows imply 5 days a week of either face-to-face, email or telephone interactions

while yellow arrows imply weekly interactions. The orange and pink colours represent two to three times and four times a week respectively.

One would also expect to find the technical staff to be involved heavily across all topics and subjects. From the socio-gram, the technical support provided by the staff seems similar to or less than the amount of interactions with the ICT-savvy teacher in each department. It suggests that there is a common perception among the teachers that the technical and facility officers are too busy and they should not ask them for help unnecessarily. Teachers in each department also seem to rely on a technically more competent colleague for quick solutions, increasing the number of interactions with that teacher. In addition, there are also pedagogical discussions about the use of ICT for which the facility and technical officers cannot assist with. It is the ICT-savvy teacher who may be able to provide that assistance. For example, the Science department showed high frequencies of interactions among themselves and with T1 and T2 and occasional interactions between S3, the key Science ICT-savvy teacher with M3, the self-proclaimed 'IT mama'. Hence, much of the interactions tended to be department-based, centring round ICT-savvy teachers.

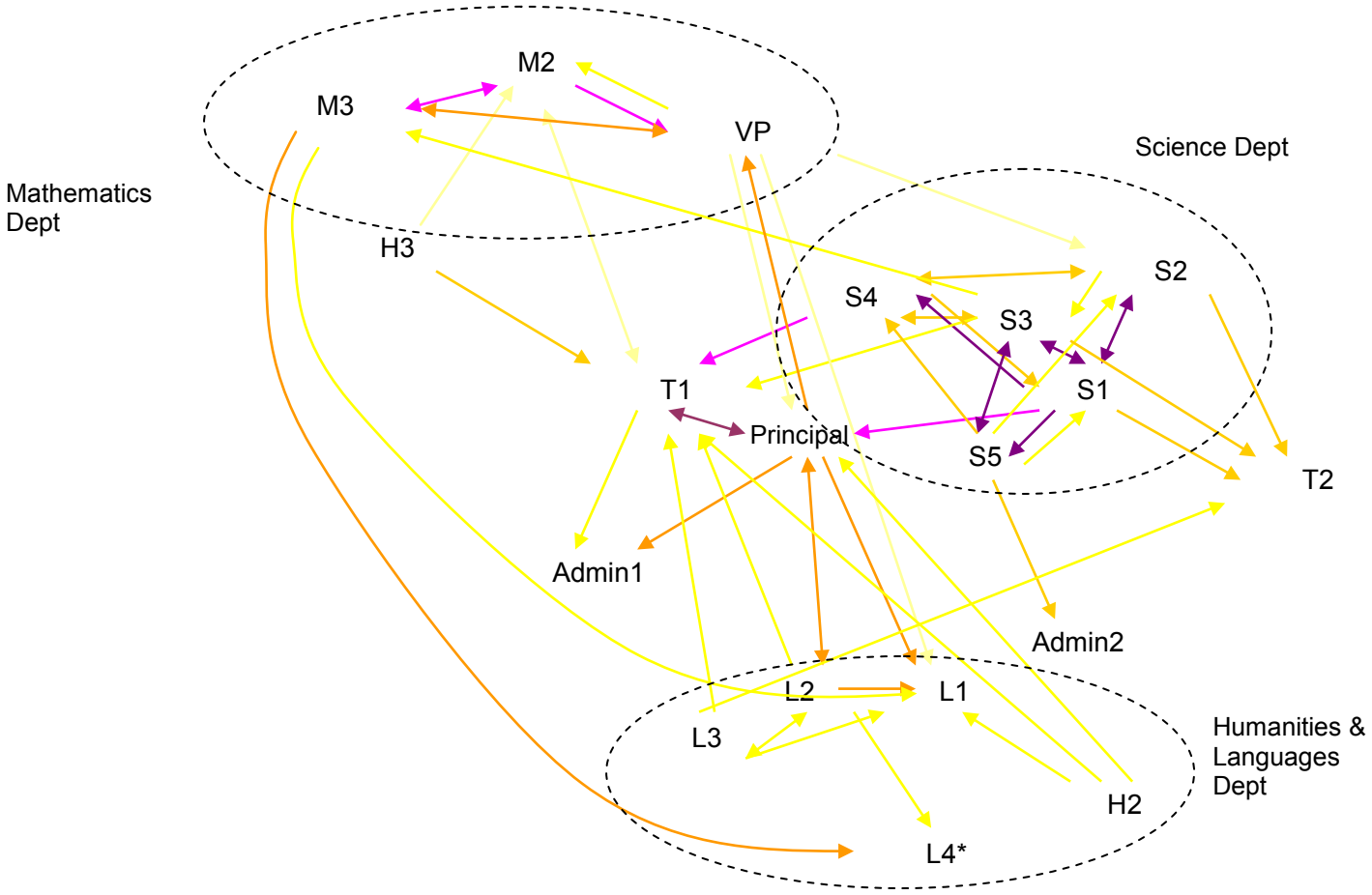


Figure 4.7. Interactional Patterns Among the Staff Concerning ICT Issues

(The socio-gram includes 1 teacher (L4) and 2 administrative staff (Admin1 & Admin2) who were mentioned by other teachers but did not participate in the study)

In summary, the socio-gram shows that:

- the technical team support the various teachers in the departments. Some HODs and teachers are ICT-savvy so the support comes from within the department.
- the interactions among teachers and management can be intensive, some can be as frequent as daily discussions about ICT.
- the most ICT-active department is the Science department with frequent exchanges among the teachers on an almost daily basis
- the HODs seem to be the key person supporting the initiatives after teachers have kick-started the process.
- there is little cross-department interaction
- management provides more support to the departments and teachers who need ICT support and motivation.

A primary difference between Cool School and government schools (based on the pilot phase interview findings of the government school teachers) is the lack of an ICT department or an ICT Head of Department (HOD) in Cool School. This observation was cited by H2 as a factor contributing to their self-reliance.

'We have to solve the problem ourselves, for the first 5 to 10 minutes…We don't have IT HOD. We don't even have a technical staff.' [H2]

The VP explicitly stated that the absence of an ICT department contributed to the teachers' ownership of the ICT projects and a sharing culture in the school.

'Don't think so [on setting up an ICT department] because once you create one…[the] responsibility is on one [department]. [I] rather have all [take responsibility for ICT]… Everybody is a mentor. Everybody is a mentee. We learn from one another.' [VP]

Based on the socio-gram, the strategy of the school management is to allow the ICT-savvy teachers to take responsibility within their own departments. This self-reliance within each department, according to the VP, is better:

'There are a few who would naturally stand out and the school doesn't have to pick. Naturally stand out ones (teachers) -- people will go to them. It is more organic that way and it is better.' [VP]

On the other hand, the management works with teachers who are less ICT-inclined (e.g. L3 and H2) to stimulate interest and provide practical solutions on ICT use. When the 'organic growth' model is considered, this support approach is intuitive since the ICT projects that are already flourishing will continue to flourish but it is the less ICT-inclined department which requires that initial leg up to kick-start the ICT innovative process. More importantly, they encourage ICT projects to grow and blossom naturally. ICT projects which are forced upon teachers can fail miserably, as L3 recounted:

‘I was the ICT head of English in a government school. They forced me to form this platform for them to get resources but only 3 people [teachers] complied….it’s quite dumb - doing it when the rest are not even won over. Then after I left the school, I realized the website closed down.’ [L3]

The Principal advocates allowing teachers to collaborate on their own with minimal interference from management, to allow teachers the space to work, grow and innovate:

‘[We are] very freed up...so somebody would send a link - this is a interesting video or website…but we don’t want to come to the point [of checking on the teachers] like [why] didn’t [you] reply because the teacher’s job [already comprises] quite a lot of (work) elements…e.g. the mentoring part.’ [P]

This freedom to explore has been so much of Cool School’s culture that S3 was surprised when questioned if she had to ask for permission to carry out ICT initiatives in her class. Her response was:

‘No, I don't ask for permission to carry out new ideas. I just do it.’ [S3]

The document (Figure 4.8.) shown below is an email trail that indicates the openness of the management to take on teachers’ suggestions.

[Deleted screenshot of email]

Figure 4.8. A Screenshot of a Teacher’s Email to the Principal and His Reply on Her Suggestion to Use Blogs to Communicate and Work

The email also illustrates the direct channel that the typical Cool School teacher has with the Principal and the openness of the Principal to new ideas. His forwarded reply to the Vice-Principal (CS) indicates how he, as the Principal, takes his staff's suggestion seriously. According to the VP, the speed at which teachers can pick up new ideas and implement them is one of their strengths.

'We are young so I think we can pick up [ideas] pretty fast…I don't think we are very skilled yet but we are able to pick up pretty fast.' [VP]

To further facilitate organic growth, teachers are encouraged to sit in on each other's lessons and to pick up useful ideas for implementation in their own class. The VP mentioned:

'The best strategy is to see something that works, be inspired and use it in your own class… We encourage [teachers] to sit in on one another's classes...We also have weekly, biweekly teachers' training. We explore everything and anything.' [VP]

The training is, to a large extent, a sharing session among the teachers on best practices and they allow the exploration of any topic which could be useful. By cultivating an open and 'freed-up' culture in Cool School, teachers feel secure in exhibiting creativity and innovate.

Section 4.5 School Policies

4.5.1 ICT Policy

The evidence presented so far describes the manner in which ICT is used in the classroom, the ICT infrastructure available and how teachers cope with limited ICT resources and training by collaborating in practical and effective ways. The key to understanding how these patterns of interactions developed in Cool School lies in the philosophy the management adopts with regards to ICT use. This section will discuss how the ICT policies influence the teacher behaviour observed.

SRQ 5: What are the teachers' and school leaders' perceptions towards the ICT policy in Cool School?

Among the policies adopted by the school management (including the Heads of Departments), there are some of which have direct bearing on ICT development while others impact the growth of the school in general. The policies are broadly categorised into:

- Push Policies
- Pull Policies
- Policies Concerning Resources
- Policies to Utilise the Strengths of Teachers
- School Technology Plan

4.5.1.1 'Push' policies

The 'pushing' from the middle management was subtly done to get the teachers to embark on using ICT in the classroom. For example, H2 (HOD for Languages) put forward her expectations to the teachers in her department clearly.

'I think I got to tell them what I expect… so there must be a benchmark.' (H2)

While H2 set a high expectation, she did not leave the teachers on their own but provided support in a practical manner. H2 added:

'I will find out why [teachers don't want to use ICT]… So if it a matter of not knowing how, then I will show them. I will find resources and sit down and brainstorm with them.' [H2]

This behaviour of 'push' and 'support' is also exhibited by the Principal who hands software and ICT materials to the teachers for their review and consideration. In this way, the teachers are constantly encouraged to implement new ICT initiatives. S1 shared about how the Principal provided sample resources to get her to think about:

‘There were some samples that…[Principal] gave me from his lesson…then we see what is the potential for ICT… [Principal] wanted us to explore this software that allows us to do quizzes online.’ [S1]

The Principal is clear on how he wants to move the ICT initiatives forward with the teachers. By sharing the ICT resources which he has used for his lessons, the Principal leads by example. This is again evidence of how Cool School management work with their staff. One point that the Principal is clear on is that he does not want to restrict the teachers by setting standardised procedures. He described his stand:

‘…one way is [to] have the standardized template…then everybody will be forced to look into that…However,… because each lesson might have a very different goal, some might [work] better using like internet-based work or movies, some might not…That’s why I don’t want to go that way [of standardised template].’ [P]

This approach to not restrict teachers is mirrored by the VP in not binding the teachers to ICT use. The VP’s justification for his stand was the high motivation level of the teachers:

‘They [the teachers] are motivated…You don’t need to have a department meeting and force everybody to use [ICT]…The top down [approach] sets the direction but the pace of how fast it runs depends on the ground.’ [VP]

Rather than forcing the teachers to do what he wants, setting a general direction for the teachers to follow and then letting the teachers work at their own pace is more effective. This is an important consideration as it is evidence of how the school management are not entirely ‘hands-off’ in encouraging ICT in Cool School.

Another indirect way of ‘pushing’ the teachers to consider their teaching strategies is through the feedback from the students. Students are asked to give a rating on the teacher’s performance at the end of the year. This feedback from the students is taken seriously to effect change as highlighted by VP:

'…there is one column in the feedback [on teachers]…[Are] the lessons…"out of the box", "not the conventional"? Usually when the score for that shows 3 out of 5, the lowest among all - it tells us that we need to change.' [VP]

H2, the HOD for Humanities, also made a similar point about teaching methods and student feedback:

'There is no fixed method. We can use chalk and talk if we want to. But then at the end of the year, your student rating will show.' [H2]

Besides the yearly rating, the students' class attendance is also a useful indicator of whether the teacher is able to engage the students during the lesson. H2 added:

'…if I see class attendance falling…my first instinct is: Is it because the lesson is boring? ...[Is it] because it is just a chalk and talk [and there is] no ICT element or visual element in it? Then…usually it is not [a] reprimand but I will tell my teachers that the basic is to have PowerPoint slides with pictures.' [H2]

With the senior management setting the general direction and the HODs supporting the teachers by gently nudging the teachers to adopt ICT in the classroom, the teachers get the idea that ICT use is important in Cool School. However, the approach is still relatively professional and unrestrictive. The approach is still to allow the teacher to take responsibility for the lesson. The 'push policies' are relatively implicit and generally take the form of setting expectations, checking student feedback and attendance.

4.5.1.2 'Pull' policies

The 'pull' policies act in tandem with the 'push' policies which together, form the overall strategy for ICT implementation. The focus of the 'pull' policies is on motivating the teachers to utilise ICT. Firstly, the Principal recognised that teachers have the final say in what is taught in the classroom:

'…[it] is very hard...you can't force it [ICT use]. At the end of the day, she [the teacher] is the main stakeholder because she is the one who ... teaches...' [P]

Correspondingly, the teachers are motivated enough to push themselves to carry out ICT-enabled lessons. S2 described his own experience:

'it's more of me…pushing myself to make lessons more interesting' [S2]

To some extent, it is also this freedom given to the teachers which makes teachers take responsibility for their lessons and to work on improving their lessons. S3 listed the areas for improvement:

'I think that there are a lot of things that I have not learned. I will change PowerPoint slides …, add videos into every lesson, help them to remember the lessons in their context… to draw mindmap … for Chemistry.' [S3]

Even though teachers are given the liberty to innovate and try new initiatives, they are also mindful that they are responsible for their students' grades and so teachers have to innovate or use ICT to better prepare the students for examinations and not just for the sake of using ICT. According to L3,

'I feel that something shouldn't be used just for the sake of using it. You must ask yourself whether that is the best way of achieving things. I think some subjects also need more ICT, like History and maybe Math… [and] English humanities.' [L3]

The positive point to L3's remark is that she has given sufficient thought to the use of ICT in the teaching of her subject. Even though the management do not force teachers to use ICT, they do facilitate ownership and buy-in to the ICT vision. For example, S1 put in an interesting defence of her Principal in terms of the support given and put the blame squarely on the teachers for not implementing ICT-enabled lessons:

'I feel that [Principal] is very 'on' [passionate] about it. I feel that the only hindrance is us, when teachers do not go with him… you just need to tell him, he will do his best for us.' [S1]

The Vice-Principal believes in inspiring teachers rather than forcing them. The Vice-Principal advocates leadership by example which includes possessing the ICT skills and taking on classes to teach. Again, the 'lead by example' approach adopted by the senior management was illustrated in his response:

'What is my working style?…definitely not domineering but more towards doing, showing, inspiring. Do first then show and in the process hope to inspire…You have to do the job… take the lead, show the way and then don't just talk about it. Do it in our classes…In Mathematics, we intentionally set aside one day in a month…for lectures...In order to engage fifty to seventy [students], we have to use ICT…we prepare better and that kind of pressure is positive…We inspire. There is no compulsion.' [VP]

The focus of the policies is on inspiring not forcing teachers to take on ICT. Setting up the support infrastructure so that teachers learn from each other is a key strategy for the school to build the ICT capability of the teachers. The Principal added:

'…you fight alongside the staff, then in term of policy making, it becomes clearer, closer… you will catch their [teachers'] attention… if they are intelligent organizational creatures, they want to get [into] the good book of their boss…so they will also use [ICT]…'[P]

Hence, leadership by example is clearly a strategy to motivate teachers to use ICT and along with the leadership comes the support. The Principal illustrated how he provided hands-on support to teachers:

'I show them what a Mac can do… sometimes it is during meeting or sometimes I pull them to the office saying…check this out and then like I know that H2 [for] social studies uses a lot of pictures so then I will show her how to crop pictures using a Mac.' [P]

The result is that teachers are inspired to follow and they hold the Principal in high regard. For example, H2 rated the Principal's ICT skills higher than hers:

'I am really not very good [at ICT]…I will rate [Principal] 8 out of 10. Myself? I will probably say about 5 to 6 [for me].' [H2]

4.5.2 Policy concerning resources

On the surface, the policy governing resource allocation appears contrary to the earlier evidence of management being supportive of ICT use. For example, there is no fixed budget for ICT due to financial constraints. Upon closer examination, the school makes an effort to source for cheap or free technology so that the resources are maximised. The Principal added that he would include IT and marketing in the budget the following year:

'…this year we deliberately want to spend more on IT and marketing so we finally have the segment of the budget…of course it [is] not like [it is] a lot.' [P]

Being highly pragmatic, the school adopts a 'start simple' philosophy to ICT use. VP explained that the downside risks are lower in the event of failure and there is little need to update the technology:

'The best approach is to start simple…like using YouTube...You don't need to have special software and is pretty consistent. …The worst…is to have a website, server of your own to run specific applications…cost is going to run up…You might also have problem catching up with technologies...We try not to re-create. We use what [is] existing because there are millions [of resources] out there.' [VP]

Having emphasised that the lack of resources is a problem in Cool School, it is also necessary to add that there are *some* resources that the school provides, for example, the SmartBoard and laptops for teachers as cited by H3:

'…a laptop for each teacher so there is no excuse that we don't have any resources.' (H3)

4.5.3 Policy Capitalising on Staff Strengths

Management is also realistic in recognising and utilising strengths of individual teachers by allowing teachers the flexibility to teach in ways that match their unique strengths. L1 stated her confidence in the leadership:

'Teachers are people, not factory workers…No concerns because the school leadership is understanding of teachers' individual strengths and interests, and not indicative of a factory processing plant.' [L1]

Another important point noted by the VP was the higher energy level and the 'unafraid to fail' attitude possessed by a younger teaching staff:

'…not because of anything but just simply because of the energy level [of the younger teachers in the school] but just physically more at twenty, thirties, you are just more energetic which gives you which translates into more time…to try out something new. You are not afraid to fail, just try.' [VP]

Exploiting staff strength may seem natural and logical in any organisation but in Cool School, teachers feel secure to demonstrate their strengths and use them for the betterment of the students. The natural selection process of hiring young teaching staff has also led to them utilising the ICT skills that they already have in the classroom, an important point concerning staff's *habitus* (Belland, 2009).

4.5.4 Technology Plan

While the focus of Cool School has always been to use innovation and relevant tools to engage the students, the approach to using ICT in the classroom seems, surprisingly unstructured and lacks long-term planning. The VP admitted that they do not have a technology plan:

'…we don't have ICT master plan 1, 2, 3. Step one roll out hardware, step two roll out software, step three train the teachers but we are going in that direction. We are much smaller so we can pick things up much faster.' [VP]

However, on closer examination, the school does have a systemic approach to keep ICT initiatives moving along. The approach is akin to a 'garden model', where both weeds and flowers grow but eventually, only the flowers remain while the weeds wither naturally. This may seem to be a waste of resources but given that the initial phase of growth does not reveal which are weeds and which are flowers, it is better to let both grow for a period of time. VP calls it 'organic growth':

'…there are so many organic programmes out there [which are] growing.' [VP]

The approach is to allow the ICT to grow organically, with the more useful strategies or successful applications growing faster and eventually spreading to all teachers in the school and these are then shared at staff meetings. There is evidence that teachers take an active role in thinking about new innovative ideas. The key seems to be in allowing these ideas to germinate and to grow till either natural fruition or that they die a natural death. For example, M2 shares her passion on innovating for the students:

'I'm looking for new things, in terms of pedagogy. If not, it will become very routine. I'm comfortable with the teaching but I want to do it [experiment] more for the students, to be more creative.' [M2]

In line with the innovation culture in Cool School, classroom teachers are constantly thinking of new ideas which could help the students learn better. Usually, the technology used is improvised from students' own mobile phone or available web services (e.g. blogs and YouTube clips). This thinking and innovation culture extends to the technical officer, T1:

'…mobile phone nowadays is getting more and more common. iPod and mp3 player are now even equipped with wireless capability…Rather than putting 40 desktops in

the classroom, we can actually put the software into 40 mobile phones or mp3 devices.' [T1]

In association with T1's idea, S2 has a similar concept of allowing mass responses in class:

'It would be best if you use ICT in class. You throw a question and everyone has a tiny laptop and then write the answer and send it straight away.' (S2)

S3 was considering facilitating the downloading of notes into the students' own ICT devices:

'I feel we don't need that 'board [Tablet]' because it is bulky…Nowadays a lot of people have iPods so they can download the lecture notes into iPod…videos… lectures like MIT…' (S3)

This is similar to what S1 was thinking about, concerning reviewing lessons online:

'If we are also exploring of putting lessons online so if students whom missed it or want to recap can go online, download the clip and see what is going on.' (S1)

It would seem that the teachers do discuss and bounce ideas off each other. The three teachers quoted above are from the Science department, aligned with the findings from the socio-gram about how teacher collaboration tends to be within-department.

By encouraging teachers to work together within their departments, the management ensure that there is sufficient support for each teacher to implement ICT projects that he or she is comfortable with. The VP adopts the perspective that changes should be gradual and deep to make sure that the shifts are fundamental and long-lasting.

'You rather have more gradual change than [change] straight away [because]…you [can] only sustain for one month or one year then your 'initiative will die'. If you have gradual change, fundamental shift in mindset, then you can sustain for ten

years…the whole landscape changes, instead of the just cutting away the grass on top.' [VP]

The school takes a long-term view to ICT implementation by shifting mindsets and changing people rather than just replacing old projects with new ones. M2 described her own experience of the gradual change in Cool School:

'We did switch from papers to slides…converted every single lesson to PowerPoint slides. One step at a time, the school will give a period, slowly. Changes are quite manageable.' (M2)

The policies put in place actively promote ICT implementation through inspiring and leading by example. By pushing change one step at a time, the school undergoes a transformation eventually.

4.6 Overall Summary

It may be useful to now locate the findings presented in the previous sections within the larger context of Cool School and ICT use.

Firstly, the findings show that the teachers in Cool School are aware of different pedagogical principles involved when utilising ICT in different ways. By deciding to sequence the lesson in a certain manner, the teachers show sensitivity (or Familiarity) to the functional value of the ICT (e.g. video clip) in maximising learning. The variations in the manner ICT resource is used (e.g. Tablet PC or video clip) lead one to question if pedagogical distinctions should be made to in relation to ICT use. It would appear that there are different pedagogies associated with specific ICT categories. Whether ICT-specific pedagogies deserve further examination is a key question to be addressed in the Conclusion Chapter.

Secondly, there is limited ICT facility, constrained by the lack of financial resources. Hence, 'cheap technology' such as free software or web-based applications is used, the cost of ICT experimentation is low and the corresponding risk is minimal. Teachers can afford to fail and learn from it. Teachers in Cool School utilise these 'cheap technologies' as a/an:

- motivational tool
- presentational tool
- production tool
- collaboration tool
- research tool
- interactive learning tool
- others: for revision, learning guidance and giving advice

These ways represent the key purposes of ICT usage in the classroom and they entail different pedagogical requirements.

Thirdly, in relation to Transparency & Connectivity, there is more evidence to support the presence of Transparency compared to Connectivity. Teachers seem to insert ICT into the curriculum (Transparency) according to ways which are relevant and

familiar to the students. However, the use of ICT to 'connect' subjects or disciplines is not obvious as the teachers are focused on getting students to pass the examinations which are subject-based.

Fourthly, to achieve the level of innovation observed in Cool School, the school management emphasise teacher ownership for their lessons and students' examination performance. Teachers are encouraged to experiment with new ideas to improve students' academic results. S1's remark about not needing to get management approval when implementing new ideas in the classroom illustrates the trust that management has in the teachers. The collegiality among teachers and management is commendable with ICT-savvy teachers leading the ICT support in Cool School voluntarily. While there is no definitive technology plan, the general approach adopted by the school management is that of the 'organic growth' model with innovation as a key principle for teaching excellence and leadership.

Leading by example, the school management attempt new ICT resources and teaching strategies and share them with the teachers. In place of the overt pressure to force teachers to adopt ICT in other schools, the management cultivate an environment of constant encouragement and positive sharing environment to nurture ICT growth. Stories of successful ICT applications are shared during meetings while failures are also recounted for all to learn from the experience. The Principal put things in perspective when he mentioned:

'The usage of ICT in [Cool School] is part of an entire curriculum, not a standalone segment. It's like a man going fishing and asking him to give a weight to the contribution of the rubber gripping of his fishing rod. Can he do without the rubber? Probably yes, in exchange for sores on his hands. Was the catch due to the rubber? Likely not, but it makes the process more comforting. I guess that's the role that ICT plays currently in [Cool School].' [P]

This perspective suggests that ICT should *not* be viewed in isolation from the other school factors which together, contribute to the overall success of a school and her students.

CHAPTER 5: DISCUSSION AND CONCLUSION

Introduction

This concluding chapter will review the results obtained from this study and generate a theoretical model to explain the data and offer suggestions on future research.

5.1 Key Issues in Study

To ensure that the learning is deep and practice-oriented, teachers seem to rely on face-to-face interaction and discussions in addition to the didactic instruction to challenge students' assumptions and knowledge in class. Table 5.1 lists the key findings for each of the SRQ.

	Specific Research Questions	Key Findings
1	What are the teachers' and school leaders' perceptions towards the use of ICT in the classroom?	Teachers and leaders are generally positive towards ICT use especially when the manner in which ICT is used aligns with their own pedagogical beliefs. Pedagogical beliefs held by teachers concerning their role to: • motivate and advise • provide information • encourage student practice, revision and production • facilitate collaboration, student research and provide learning guidance • facilitate activity-based learning
2	What are the teachers', school leaders' and technical staff's perceptions towards the available ICT infrastructure in Cool School?	Depends on the type of ICT e.g. sufficient resources for PowerPoint presentations but insufficient resources for interactive learning Cool School is still better than other private schools, in terms of available ICT resources
3	How do teachers and school leaders view the link between technology and teaching?	Technology can be incorporated into didactic teaching e.g. PPT, video clips Disparate views on whether presentational modes of ICT use constitutes ICT (e.g. PowerPoint slides) Learning through interactive software and ICT-enabled cross- disciplinary approaches are almost non-existent
4	How do the management and	Collaboration tends to centre round key resource

	teachers collaborate to implement ICT initiatives in the school?	persons within the each department
5	What are the teachers' and school leaders' perceptions towards the ICT policy in Cool School?	Organic growth culture supported Managements is supportive with minimal interference until teacher-led initiative is ready for mass implementation

Table 5.1 Key Findings for the Five SRQs

The teachers also resorted to other innovative means of using ICT such as:

- Use of home-based ICT equipment (utilising students' own computers) e.g. home assignments
- Use of software which allows self-authoring of content (e.g. computer software which allows teachers to put in the relevant content in a format similar to 'Who wants to be a Millionaire?')
- Use of students' mobile phones (as a mass response device)

As described in the Results Chapter, the effectiveness of these student-based approaches is questionable with the first two bulleted strategies listed above more successful than the last. In any case, teachers are constantly exploring other means of integrating ICT into the curriculum. To facilitate the process, some teachers have asked for customised training in the areas of using hardware (e.g. SmartBoard) and software (e.g. flash animation) to employ ICT effectively in the classroom, a situation not unlike the teachers in Donovan *et al* (2007)'s study.

There are a number of interesting results generated from this study on Cool School, all of which are linked to the relatively unique characteristics of Cool School. There are also some observations which are not adequately explained by the literature reviewed in Chapter Two.

5.2 Inadequacies of Current Literature

5.2.1 Roger (1995)'s Typology of Teachers

On the surface, Roger (1995)'s typology of teachers from early innovators to laggards (Chapter 2, page 18) seems sufficiently comprehensive and intuitive. However, based on the findings from this study, there appears to be major gaps in the model. For example, L1 indicated her apprehension at using ICT in class, especially in using PowerPoint or video clips for lessons.

'(Not motivated to use ICT in class) because there are so many options that we have not researched yet. ICT is only one of them.'

A closer examination of her responses revealed that she was using more activity-based learning in class away from the computer.

It is to see how you see yourself as a teacher and then passing it (the information) on. I'm not doing (ICT lessons) that often because I get a lot more out of being away from the computer.

Even more interesting is her switch to being an ICT convert in the use of blogs for students to record their responses to videos clips or articles. She was so enthusiastic about this approach that she emailed the Principal on the effectiveness of the blog in teaching English.

Based on the typology, L1 would have been labelled a laggard since she did not employ PowerPoint slides or use video clips as early as the other teachers. However, upon stumbling on the use of blogs to store students' assignments and as a portal for communication, she moved quickly to propose the use of blogs to the Principal for professional sharing. Simply put, L1 became a 'laggard' in Cool School, not due to the lack of confidence or disinterest in ICT but a lack of student-centred ICT options. Based on the case of L1, it is obvious that Roger (1995)'s typology of teachers presents too simplistic a picture of ICT implementation. It disregards the interaction between the teachers' response and the type of technology available for

implementation. As a result, using only a time-sensitive measure such as the speed of ICT implementation presents only one side of the picture to the situation. A more sophisticated model to account for both technology and pedagogy may be needed.

5.2.2 TPCK Model by Mishra & Koehler (2006)

Notably, the TPCK Model does provide useful descriptions of how teachers implement ICT in the classroom, based on the three constructs of Pedagogical Knowledge (PK), Technological Knowledge (TK) and Content Knowledge (CK). In the case of L1, the teacher decided not to embark on PowerPoint presentations but rely on face-to-face disccussions to facilitate learning of English grammar and vocabulary. Here, the PCK is illustrated since the interaction is really between PK and CK. However, her attitude towards ICT changed with the use of blogs for learning. As such, TK was then illustrated when she experimented with blogs on her own. When L1 embarked on using blogs to facilitate student discussion on English grammar and comprehension, the event illustrated TPCK with the incorporation of technology into the content and pedagogical activity. When used as a descriptive model, TPCK does provide some measure of explanation to teachers as to how the three constructs interact. Of greater interest would be the question on how then to make ICT-based lessons more effective. It is still unclear how the PK interacts with the TK or the CK. Are there different levels of interaction? Do certain types of technology work better with specific pedagogical activities for particular topics? The issue of 'fitness-for-purpose' between the technology used and the pedagogial approach is not addressed.

At the school level, if TPCK is the focus when it comes to ICT implementation in the classroom, does that mean training of teachers and sharing of ICT resources such as lesson plans have to occur at the level of individual topics? If that is so, how long will such topic-specific ICT training and sharing take? Is such an approach feasible or even practical?

In general, TPCK Model does not seem to be able to answer these questions sufficiently for school administrators and teachers to know how to best take the next step when it comes to crafting the ICT plan or when preparing for the next lesson. A

more practical model with recommendations of possible implementation strategies will be something that teachers and administrators will welcome.

5.2.3 Hypertext Model by Schussler et al. (2007)

The Hypertext Model (2007) may be more practical and comprehensive than the TPCK Model in that it captures the impact of ICT implementation using the five dimensions in the model. It examines dimensions which span different areas e.g. intra-psychological (e.g. Familiarity) and inter-personal (e.g. Collegiality). The difficulty becomes apparent when it is applied to real-life data. The Hypertext Model can be confusing especially when some of these dimensions overlap. Based on the results of this study, below are some criticisms of the Hypertext Model.

a) Familiarity

Firstly, Familiarity which concerns pedagogical expertise and understanding of students' academic and social needs does not explicitly address the technology part of the equation. Being pedagogically sound does not equate a strong ability to use technology in an effective manner during the lesson. While the application of technology is addressed under the Transparency dimension, there is little said about the pedagogical expertise of teachers in relation to technology use. The Hypertext Model may eventually describe teachers who can apply technology to teaching (Transparency) without understanding the rationale or theoretical underpinning for such technological interventions or strategies. There may also be teachers who are skilled at pedagogy for non-ICT-enabled instruction (i.e. high on Familiarity) but whether these teachers will exhibit the same pedagogical soundness when asked to conduct lessons using ICT is debatable. My argument (drawing from the TPCK literature and the data collected) is that technological pedagogy goes beyond general pedagogy (Familiarity). Technological soundness requires teachers to understand the characteristics of the technology in order to apply it to teaching. For example, L3 illustrated her 'technological pedagogy' concerning the manner in which subjects can be taught effectively using technology:

'It's about the user using the technology, not the other way round… I feel that something shouldn't be used just for the sake of using it. You must ask yourself

whether that is the best way of achieving things. I think some subjects also need more ICT, like history you need more slides, and maybe Maths.' (L3)

In short, 'technological pedagogy' is about the sound and reflective manner in using technology for effective learning. It is a more technology-specific notion of pedagogy than Familiarity. Hence, there may be a need to review the usefulness of Familiarity and to consider adapting Familiarity to something more technology-specific.

b) Facility

Similarly, the second dimension, Facility lacks the specificity needed for application to the classroom context. The issue with Facility is that it addresses the teachers' understanding and implementation of *any* technology without specifying the type of technology being used by teachers. There is little specification of technology for self-use, administration or instruction. As shown in the Becta (2009) study, teachers and students carry technology in the form of mobile phones, laptops, MP4 players and iPads with wireless access to internet available in many schools. YouTube video clips and FaceBook accounts are often cited by the teachers in this study. Hence, if assessed based on Facility, most schools will obtain a high score on this dimension, according to the Becta (2009) study. However, this piece of information is not sufficiently useful as teachers may be using PowerPoint slides to lecture, a piece of software for administration purposes such as keying in test scores or an interactive learning software to engage learners in a research project. The impact of these three uses of technology on student learning will vary widely. Hence, while Facility addresses the technology component of the ICT implementation equation, there needs to be further specificity to the types of technology involved. For example, the results of this study showed the following functions to ICT use in Cool School:

- motivational tool
- presentational tool
- production tool
- collaboration tool
- research tool
- interactive learning tool
- others: a tool to for learning guidance, revision and giving advice

More interestingly, these functions are related not just to any type of technology but to 'cheap technology' in Cool School. To a large extent, it is not the availability of technology but rather the availability and use of adapted technology in the classroom that matters. Can teachers use the technology in the classroom? Is the ICT resource (e.g. video clips) aligned to the curriculum? In this respect, there is a need to consider the degree of technology adaptation required and the availability of these adapted technology rather than technology in general.

c) Transparency

Schussler *et al.* (2007) attempt to bring together the Familiarity and Facility dimensions through the Transparency dimension. The focus of Transparency is on the integration of technology in classroom teaching. While it is an important concept, it may be redundant especially if it is seen as the interaction of both Familiarity and Facility dimensions. A teacher scoring highly on 'technological pedagogy' and the related facility will naturally score highly on the Transparency dimension since by definition, Transparency is the use of the related technology (facility) in an informed and pedagogically sound manner (familiarity). It seems confusing to use the three dimensions especially when they are interrelated.

The confusion is most apparent when one compares the findings placed under the Familiarity, Facility and Transparency sections of the Results Chapter. For example, I had problems locating the following quotation from M3 concerning her use of an online game for teaching Mathematics:

'Teach mathematics. Oh yes we do, 'Deal or No Deal' via the online game so we did that with the kids to teach them about probability and making choices. That was a one off thing, one of the topic we could apply.' [M3]

Eventually, the quotation was placed under Familiarity but it could easily have gone under Facility if the focus was on the technology used or Transparency if the focus was on the ICT implementation process. The same dilemma applies to many of the other quotations found in the Transparency segment (Section 4.3). This overlapping of dimensions creates unnecessary layers of complexity which can be easily solved

if Transparency is removed and the Familiarity and Facility dimensions are redefined to relate to technology use.

d) Connectivity

In a similar vein, Connectivity exhibits the same issue of overlapping dimensions with Familiarity and Facility. Moreover, there are rare cases where teachers teach concepts which are cross-disciplinary. For example, the mini project cited by M3:

'Those [students] who [spend] 2 years with us…have projects to do - mini projects, so they have to source for information, the evidence and the history of the topic they are doing…integrated, interdisciplinary…' [M3]

In general, however, there is little evidence of Connectivity exhibited by Cool School teachers from this study. While the study may not be representative of other schools, it does make one question the usefulness of Connectivity as a dimension in the model. Can Connectivity be subsumed under Familiarity or Facility since it is another application of ICT to teaching? This will reduce the number of dimensions required to sufficiently describe the parameters involved in ICT use.

e) Collegiality

The last dimension, Collegiality, in the Hypertext Model (2007) appears highly useful from the results of this study. Besides illustrating the support required, Collegiality also provides a more macro perspective to how ICT implementation can succeed. Sub-factors such as management style, school culture, peer support on top of technical support and teacher training are equally important. Hence, collegiality deserves to stay in the model. In fact, it should be further enlarged to include temporal interactions (e.g. one-off requests for technical assistance) and project-based interactions (e.g. blog committee) to better map the ICT-related interactions taking place in the school.

f) Use of Hypertext Model to Generate a School ICT Profile

Finally, there is little indication as to how these dimensions work together to generate a clear profile of what happens in the school or the classroom. For example, will a teacher with a high level of Familiarity and a low level of Collegiality experience

much success at implementing ICT? Other than providing a comprehensive profile of a teacher or school, the Hypertext Model does not seem to provide any solution going forward in terms of ICT implementation. The findings from this study suggest a possible means of generating a clear ICT profile for schools to use.

5.2.4 An Alternative Model to the Hypertext Model

The following observations and proposals are made, based on this study, to address the shortfalls mentioned above:

a) Reviewing the Six Categories

Firstly, the issue of keeping the six categories of ICT use extracted from the literature intact needs to be addressed. The findings from the study appear to substantiate the presence of these six categories, with the addition of another three functions (learning guidance, revision of work and advising students) which one or two teachers cited. One possibility is then to place these three functions as separate categories. However, by doing so, it will make the model (with nine categories) difficult for practitioners, namely teachers and school administrators, to use in a practical manner on the ground and it is likely that the nine categories will overlap somewhat.

One other option is to place these three additional functions together as supporting instruction, similar to the category of motivating students. However, close examination of the three functions reveals that they are different from each other from the pedagogical point of view, with advising students as being predominantly teacher-directed, learning guidance process as being more collaborative while the revision of work by students which may involve active practice and is likely to be student-driven. The functions are also relatively specific and akin to tasks rather than broad categories of actions carried out by the teachers or students. For example, L2 described how she influenced the students in an incidental manner by allowing them to read her blogs, for emotional coping.

'(blogs)…but that is not for learning, more for emotional coping. Sometimes I read their blogs so I can find out what they are doing…Then my kids will read my personal blog…even the non-compliant ones. They will skip the class but read my blogs. I have no idea why.' [L3]

Based on the arguments above, subsuming these additional functions under the six categories or expanding some of the categories to include these functions may be more practical and theoretically sound.

With regards to the function of giving advice, the purpose was to motivate students to learn. Hence, it may be worth considering expanding the 'Motivating Students' category to include the function of 'giving advice'. ICT also provided a means for students to revise their work. As for the function 'revision of work', the purpose here is to get students to make sense of the learning they have undergone with some form of expected outputs from the students. In this regard, combining it with 'producing work' may be sound as both activities focus on expected outputs in some form or other. The third function of providing learning guidance by posing questions and answering student queries constitute a collaborative approach between the teacher and the students. While the original 'Collaboration' category focuses on student-to-student collaboration, it is actually logical to expand this to include teacher-and-student collaborations which may include discussions with teachers and other experts. Hence, 'providing learning guidance' is subsumed under the 'Collaboration' category with the definition of collaboration being expanded to include teacher-student collaborations.

In summary, the findings of the study suggest that the six categories originally extracted from the literature need to be expanded to include other functions, to reflect a broader scope of ICT utilisation in schools. These three additional functions are subsumed under or merged with these categories:

- Category A: Motivating and advising students
- Category C: Students revising and producing work
- Category D: Collaborating with students to guide learning

Table 5.2 below shows the expanded categories with the additional three functions:

Category	*Purpose / Application*
E) Interactive Learning	For interactive learning Direction of Information flow: ***(ICT ←→ Students)***
D) Collaboration, Research & Learning Guidance	For collaboration, sharing of information and social networking; includes research work with others Direction of Information flow: ***(Students/Teachers ←ICT→ Students)***
C) Production & Revision	For producing and revision of work Direction of Information flow: ***(ICT → Students → ICT)***
B) Presentation	For presenting information Direction of Information flow: ***(ICT → Students)***
A) Motivational	For motivating and advising students ; providing stimulus for reflection ***(ICT → Students)***

Table 5.2 Categories of ICT Use

Although these categories are distinct in terms of their functions, the pedagogical requirements on the part of the teachers may be less distinct for certain categories, for example, ICT as a collaboration and research tool. As described in the Results Chapter (page 140), both categories entail socio-constructivist learning pedagogies which suggest that these two categories can potentially be merged to form one category on the basis of the 'technological pedagogy' required of teachers. For both collaboration and research functions, students can work with others – peers or experts to obtain information for their own learning. Teachers are essentially facilitators in the process, mainly to direct their learning process and to establish boundaries for the activity. Hence, there may be some grounds to merge the two categories for the purpose of simplifying the model and for ease of use. It is important to note that these categories are formulated based on a small sample of teachers and all of them based within one private school so it is questionable if the same categories apply to the other schools. However, for Cool School, the categories make sense because of the highly varied approaches adopted by the

teachers with regards to ICT use. Hence, when arranged from didactic (teacher-directed) to constructivist (student-centred) use of ICT, the different categories will look like that presented in Table 5.2. The direction of information flow is also indicative of how constructivist or didactic the exchange is between teacher, student and ICT resource.

As a point to note concerning the inclusion of Category (A) in the table (using technology to motivate students) that while motivation may not be about information or skill impartation which the other 4 levels comprise, it is a very important use of ICT in Cool School. The teachers (e.g. S2, M3 on p.103) have highlighted the necessity to motivate the students first when beginning a topic. Hence, from the perspective of ICT usage, it is important to leave Level 1 in the table due to its importance to Cool School teachers.

b) 'Technogogy' instead of Familiarity

Interestingly, the study found Cool School teachers adopting commercial technology, much of it free or at low cost (or what I term as 'cheap technology') for use in the classroom. This adaptation of use by teachers shows a repertoire of pedagogical skills and flexibility specific to technology use. These skills include the teachers' ability:

- to identify the application of new technologies to classroom teaching and learning
- to select relevant technology that is of interest to students
- to modify lesson plans based on the characteristics of the technology
- to exhibit flexibility in modifying instruction in the event that technology fails at the last moment

Given that current terminology 'Pedagogy' and 'Familiarity' do not accurately describe these technology-specific pedagogical skills, I propose the term 'techno-gogy' which describes the specific types of pedagogical skills required when implementing ICT use. It is a subset of pedagogy, relating specifically to the use of technology in the classroom. An example of 'technogogy' is the teacher's skill at utilising PowerPoint slides from purely presentational to an interactive mode through using "Who Wants to be a Millionaire?" format. With a clear understanding of

pedagogy, teachers can then develop or embed technology into the lesson to achieve the learning outcomes. The focus is always on learning and pedagogy with the technology progressively subsumed within it. As such, 'technogogy' deserves a sub-category of its own within the field of pedagogy due to the unique skills involved in maximising learning through the use of different types of ICT.

A teacher can be good at non-ICT-enabled pedagogy but poor in technogogy due to inflexibility in using technology in a pedagogically sound manner. Experience in both classroom teaching methodologies and technology use will provide teachers with the basis to acquire technogogical skills which are really an amalgamation of teaching methodologies and suitable technologies to bring about effective learning.

In the study, many of the teachers displayed a high level of technogogical awareness and skills even though they have not been formally trained as teachers. Many utilise their own experience as learners and technology users when applying ICT to classroom teaching. In fact, S5 and S3 consider conducting an ICT-enabled lesson (or technogogy) easier than a non-ICT activity such as cooperative learning (or pedagogy in general):

'I think ICT is easier because [in] cooperative [learning], you have to spur them, hint at them, come on, talk to each other, discuss, share your ideas. … but [for] ICT, I think everyone will understand because I think 90 to 100% will use it.' [S5]

'I feel that group[work] is more difficult. It depends on the dynamism of the class, so this is something that is not controllable.' [S3]

Hence, the justification for Technogogy is that it is pedagogy which is ICT-mediated. By placing Techogogy as a sub-category of pedagogy, it highlights the differences between ICT-enabled and non-ICT-enabled pedagogies and deservedly so, because of the many intricacies involved in the interplay of technology with teaching strategies. For example, the technogogical skills involved in facilitating social interactions via social networking platforms are very different from facilitating cooperative learning in class. In online collaborations, the interactions may be

asynchronous with no face-to-face contact which leads one to question authenticity and user identity.

A further point is that Technogogy can then be located within the larger context of classroom pedagogy - how ICT-enabled segments synergise with the non-ICT-enabled segments. A teacher may use ICT to present the information and supplement it with a learning activity that is not ICT-enabled. In so doing, the lesson becomes highly effective and pedagogically sound by riding on the strengths of ICT and group learning, for example.

c) 'Teachnology' instead of Facility

Likewise, the issue with Facility, on the other hand, is the lack of the educational dimension in how technology is used. For example, in Cool School, teachers use YouTube video clips on Susan Boyle, Facebook and blogs for online group discussions. These are free software and generic ICT resources designed for entertainment, social networking and other purposes, but are used liberally in Cool School to help students learn.

'Like (most) private schools,…we don't have the money to buy a lot of big software…but because of that , it forces us to use what is existing, free, that is available, that all the students will have.' (H2)

On the other end of the Facility spectrum, there is also ICT specifically developed for educational purposes which include educational games and Wii-like software programmes for training skills. In Cool School, there is special software that accompanied the SmartBoard and some teachers used this customised software to showcase information involving transitions (e.g. changing of alkyl groups in Chemistry). However, more than the types of technology used in teaching, the attributes of the technology which lend themselves to being useful resources in the classroom ought to be addressed and highlighted. In short, the terminology 'technology' or 'Facility' does not adequately describe the specific requirements or attributes found in ICT resources which make them appropriate for use in education.

Based on the study on Cool School, there are several types of technology used which could be differentiated based on the ease of use in teaching and the purpose it achieves. For example, video clips are heavily used in Cool School to illustrate key concepts. These video clips can be from movies and usually serve the function of making the lesson relevant and hence motivating or to visually illustrate the concepts to be taught. Hence, these video clips are generic and can be easily found for the teaching of a concept. On the other hand, if the teachers want to develop a specific piece of interactive software to teach a particular concept (e.g. alkyl group replacement in Chemistry), the software has to be specially developed by a team of specialists and will take time and resources to develop.

To better illustrate the differences among the different types of technology used in the classroom, Table 5.2. below summarises the 5 types of adapted technology for learning and teaching or what I term as 'Teachnology', in place of Facility. 'Teachnology' is defined as technology (both software and hardware) which possesses certain attributes which make them appropriate for use specifically for teaching and learning. Hence, a mobile phone may not be considered Teachnology unless the students use it to send answers to their teachers. Likewise, a blogsite is not Teachnology unless teachers adopt it as a discussion platform on Geography, for example. Thus, Teachnology is the educational subset of the technology available in the world today. By giving a name to this category, educators and technologists can now identify key characteristics of technology which can be further exploited for use in learning and teaching. From the results of this study (specifically Section 4.1), there is some evidence that Teachnology can be split into different categories of use in the classroom. Each category of Teachnology is determined by *how* ICT is used rather than *what* is used. In this regard, it is possible that certain technology (e.g. video clips) can be found in different categories (for motivation and/or for presentation). Hence, it is important *not* to associate each category of Teachnology as a specific technology or group of technologies, but rather with the attributes of the Teachnology category. This will create greater flexibility in using different types of Teachnology to achieve different learning objectives, based on the appropriate technogogical skills. It is also in this manner that the focus of Teachnology and Facility – the former being how the technology is used while the latter being the type of technology used.

For example, ‘Motivation’ Teachnology (or Category A) involves technology which can be used to excite students. This may include technology that is widely available, requiring little re-development (e.g. generic resources such as commercial movies) or it can involve blogs and FaceBook discussions as platforms for teachers to give advice to students. Category B Teachnology involves mainly presentational type of materials which require some injection of content e.g. PowerPoint slides or video clips. While the use of video clips is found in both Categories A and B, the manner in which the video clips is used is different. Category A video clips will need to be captivating and something that the students are able to relate to. A Category B video clip has to be relevant, clear and informational. Hence, the type of technology (video clip) is the same, the teachnology is different as the purposes of use are different. Why is this distinction important? Compared to perceiving the types of technology as they are (i.e. as video clips), focusing on teachnology (the purpose of use), teachers can consider different types of technology to achieve the same purpose (e.g. blogs, video clips, PowerPoint slides to present information). Hence, this recasting of technology into teachnology broadens the discussion on technology to how it is used rather than what is used. In much of the literature on ICT (e.g. BECTA, 2009 Zander, 2004), the focus is on the different types of technology (e.g. Internet, Interactive Whiteboards and data projectors). This can be confusing as technology can be used for different purposes, from research to motivating students. Likewise, some teachers (e.g. L1) refuse to use technology for specific purposes and so, it is not about the technology but rather the purpose behind using the technology. In this regard, examining teachnology (the purpose of using the technology) may be more useful than examining technology use.

Production (Category C) Teachnology focuses on student’s work (or revision of work) being done with the help of technology e.g. online quizzes and assessments. Again, it is not about specific technologies but rather the manner in which technology is used to help students produce work that is important. Teachers can utilise different technologies to achieve this purpose of getting students to express their competence. Collaboration (Category D) Teachnology refers to technology which facilitates collaborations, research and discussions. This type of Teachnology requires active participation on the part of the students. Technology such as blogs,

forums and FaceBook will allow teachers to achieve the purpose of facilitating discussions and collaborations among students and teachers. Finally, Interactive Learning (Category E) Teachnology engages learners by having key learning objects incorporated into software and hardware for the learners to use and learn. Often, to make the learning objects suitable for the learners, the software and hardware require customisation (e.g. learning games on Singapore history). Interactive Learning Teachnology can be expensive due to the manpower and resources needed to programme or adapt the software and possibly, hardware. As a result, there is little evidence of such Teachnology used in Cool School due to the cost involved. Some 'generic' resources such as 'Deal or No Deal' as mentioned by M3 can be adapted for use as quizzes but they are used to elicit answers from the students rather than for them to pick up new information. The focus is still on production – more of a Production rather than Interactive Learning Teachnology. See Table 5.3 for a summary of the categories of Teachnology and Technogogy and how they are associated with the purpose of the application.

			Teachnology		**Technogogical Skills**
Cate gory	***Purpose / Application***	***Description***	***Hardware***	***Software***	
E	For students to engage in interactive learning Direction of Information flow: ***(ICT ←→ Students)***	Strong infusion of Technogogy into the customised technology to match curriculum and learner needs	Equipment to enable learner to respond to the virtual environment. Wii game console adapted for skill training e.g. technical drawings	Interactive games customised to help learners achieve specific learning objectives	High degree of Technogogy and ICT programming skills required; Involves a team of developers; possibly at Ministry or whole school level May lack flexibility for adaptation to individual teacher's or class needs
D	For students to collaborate, receive guidance and conduct research	High injection of content by users onto social networking platforms and	Learning platform, server & networking hardware tools e.g. speakers, microphones,	Learning portals, Social media tools e.g. blogs, Skype FaceBook,	Skills in facilitating discussions and focusing on key issues; need to set clear rules for discussions; the sharing and gathering of

Cate gory	*Purpose / Application*	*Description*	Teachnology		Technogogical Skills
			Hardware	*Software*	
	(Students / Trs ←ICT→ Students)	learning portals	Blackboard	Wikipedia	information
C	For students to produce and revise work ***(ICT → Students → ICT)***	Riding on available technology for production of work	Personal ICT quizzes and blogs or forums to host questions posted by teachers	Learning portals, Online quizzes, Social media tools e.g. blogs, FaceBook, YouTube	Key assessment skills in ensuring the tasks are compatible with the students' abilities and the learning objectives The focus is in assessing students' performance.
B	For teachers to present information ***(ICT → Students)***	Some injection of content onto presentation software based on curriculum needs	Classroom ICT equipment e.g. Interactive Whiteboard, data projectors	PowerPoint slides Self-made video clips	Skills in presenting information in a stimulating and punchy manner; instructional design principles and infusion of non-ICT enabled activities into the lesson will aid learning
A	For teachers to motivate and advise students ***(ICT → Students)***	Technology applied to education without adaptation	Personal ICT e.g. Tablet PCs Netbooks Mobile phones	Commercial YouTube video clips blogs Commercial websites	Technogogical skills focus on the use of ICT to motivate students to like a topic Skills and time needed to select effective resources

Table 5.3. The Relationships Between Teachnology and Technogogy

These categories of Teachnology lead to further implications for the classroom teacher and school. Firstly, there are implications on how teachers should be trained to use different categories of Teachnology which in turn, require different skills in terms of adapting technology for classroom use and identifying the right purposes for

their use. As such, the development of Interactive Learning Teachnology is usually carried out by a team of curriculum and technology specialists. In summary,

> Teachnology is characterized by the functions that the technology supports rather than the actual technology itself. By focusing on the attributes of the technology and grouping them accordingly, teachers can focus on how to use the technology to achieve the learning purpose. To fully exploit the different categories of Teachnology, matching technogogical expertise and belief with the Teachnology available is critical for implementation success.

Two examples described in great detail in Section 4.3 concerning L1 and S3 illustrate the importance of matching the right category of Teachnology with the teacher's technogogical beliefs and expertise. With L1, the initial mismatch between technogogical belief and Teachnology, notably her belief in constructivism, led to little use of presentation slides and ICT in general. However, with the 'discovery' of blogs, L1 embraced ICT to the extent of championing the use of blogs and online forums in the English Language department. The point to note here is that Teachnology and Technogogy ought to be examined together rather than separately, in order to make sense of the implementation issues that teachers face in using ICT in the classroom.

Specifically, if the Teachnology has already been developed, then the classroom teachers just need to be familiar with the Teachnology and apply it in the classroom. Little adaptation of ICT is expected. However, the irony is that because Teachnology is already customised for their use, some teachers may find the Teachnology ill-suited to their teaching style and their student's learning needs.

d) Streamlining from 5 to 3 Dimensions

By definition, Technogogy and Teachnology encapsulate the key pedagogical and technological issues originally found in the four Hypertext Model dimensions - Familiarity, Facility, Transparency and Connectivity. With Technogogy and Teachnology, the alternative model becomes more streamlined and targeted at ICT

implementation. The suggested new model (see Figure 5.1.) will have only 3 dimensions as shown below.

Technogogy (the pedagogical skill to use ICT for learning and teaching)
Teachnology (the technology clustered together based on similar attributes to achieve specific teaching and learning purposes)
Collegiality (the support from management, colleagues and students for ICT use in teaching and learning)

Figure 5.1. Definitions of 'Technogogy', 'Teachnology' and 'Collegiality'

The first two dimensions 'Technogogy' and 'Teachnology' were discussed in detail earlier. Technogogy deals with the pedagogy required for technology use while Teachnology refers to the categories of technology with similar attributes to bring about specific learning and teaching purposes. Some Teachnology involve ubiquitous resources such as mobile phones and YouTube video clips but are adapted for classroom use.

The third dimension, Collegiality, is split into three components according to the three key actors in the school: school management, other teachers and technical staff. In Cool School, these actors exert different degrees of influence on the teacher using ICT resources. Table 5.4. summarises the influences that each actor has on the process of ICT. It also illustrates that Collegiality needs to be in line with the category of Technogogy and Teachnology used in order for it to be effective.

Category	Purpose / Application	Collegiality (School Management)	Collegiality (Other Teachers)	Collegiality (Technical Staff)
E	For interactive learning e.g. Interactive games; simulations	To provide large amount of resources, time and expertise needed for development of ICT	To support the use of the customised ICT	To train teachers to use customised ICT To support hardware and software use
D	For collaboration, learning guidance, sharing of information and social networking; research e.g. Blogs FaceBook, Wikis	To encourage the use of ICT resources for collaborations and research	To share ideas on the use of networking sites or online research sites	To help teachers set up and use these sites
C	For producing and revising work e.g. online quizzes and blogs	To encourage use of ICT resources for submission of student work	To source for online quiz or blogs where assignments can be posted	To train teachers in the use of these resources
B	For presenting information e.g. Teacher-made video clips, PPT slides	To provide basic classroom ICT resources and training To encourage innovative use of ICT	To share presentation slides and ideas with each other	To support teachers in set-up of presentation equipment
A	For motivating and advising students e.g. commercial video or sound clips, personal mobile phones	To allow teachers the liberty to try (i.e. organic growth model) To encourage innovative use of ICT	To share useful ICT resources found online e.g. YouTube video clips	To support teachers in innovation practices

Table 5.4. Types of Collegiality Required for ICT Implementation

Again using L1 as the case, the collegiality required support from school management, online searches for blogsite or forum and suitable training of teachers to use these resources. All three areas were provided for, especially the support

from the school management which included an email from the Principal to the Vice-Principal to provide the necessary support for L1.

With the implementation of the 'No Textbooks' initiative involving iPads as a replacement for physical books in 2012, it remains to be seen which category of teachnology it is targeted at. Given that there is flexibility in how the iPad can be used, teachers may choose to have students go online to specific video clips to spur interest in the topic (for motivation), watch a PowerPoint slideshow (for presentation), type a response to a question online (for production), conduct research on a topic in class (for collaboration) or try out a customised software for learning (for interactive learning). Again, the teachers' Technogogical expertise comes into consideration here as teachers choose the category of Teachnology and Technogogy they are comfortable with and believe in. The type of collegiality needed will then vary in accordance to the category of Technogogy and Teachnology employed. The strength of Cool School is that the Collegiality is very high. This study seems to show that there is high level of support from the school management, teachers and technical staff.

As compared to Schussler et al. (2007)'s Hypertext Model, the modified version presents a clearer picture of the Technogogical skills, Teachnology and Collegiality required for successful ICT implementation. It can be used at the school level as well as at the individual teacher level. The new model makes it easier for schools to apply when determining their technology plan and areas to focus on. At the individual teacher level, the modified version allows the teacher to locate himself or herself on the rubric and determine how best to develop one's professional practice. The manner in which Technogogy, Teachnology and Collegiality interact needs to be further examined to determine how the model ought to be applied to school settings.

5.3 Locating Expertise and Resources using the Model at School Level

The model proposes that the manner in which the three areas Teachnology, Technogogy and Collegiality interact contribute to the effectiveness of ICT use in schools. Each category of ICT implementation has different specifications and foci so it is important to first ascertain the type of Teachnological resources, Technogogical

skills and Collegiality available in the school. Following which, the school may want to decide which category of ICT implementation it wants to focus on based on the available resources so as to leverage on existing resources. The argument is that when there is misalignment among the three dimensions, meaning that either Collegiality, Teachnology or Technogogical skills is not available to sustain the implementation of ICT in the school, it is highly likely that the targeted intent will not be met. Hence, based on the model, it is important to ascertain the degree of *fit* or alignment across the three dimensions, in order to ensure success of implementation. Below is the proposed **'iTEaCH (ICT-Technogogy-and-Collegiality Holistic) Implementation Model'**.

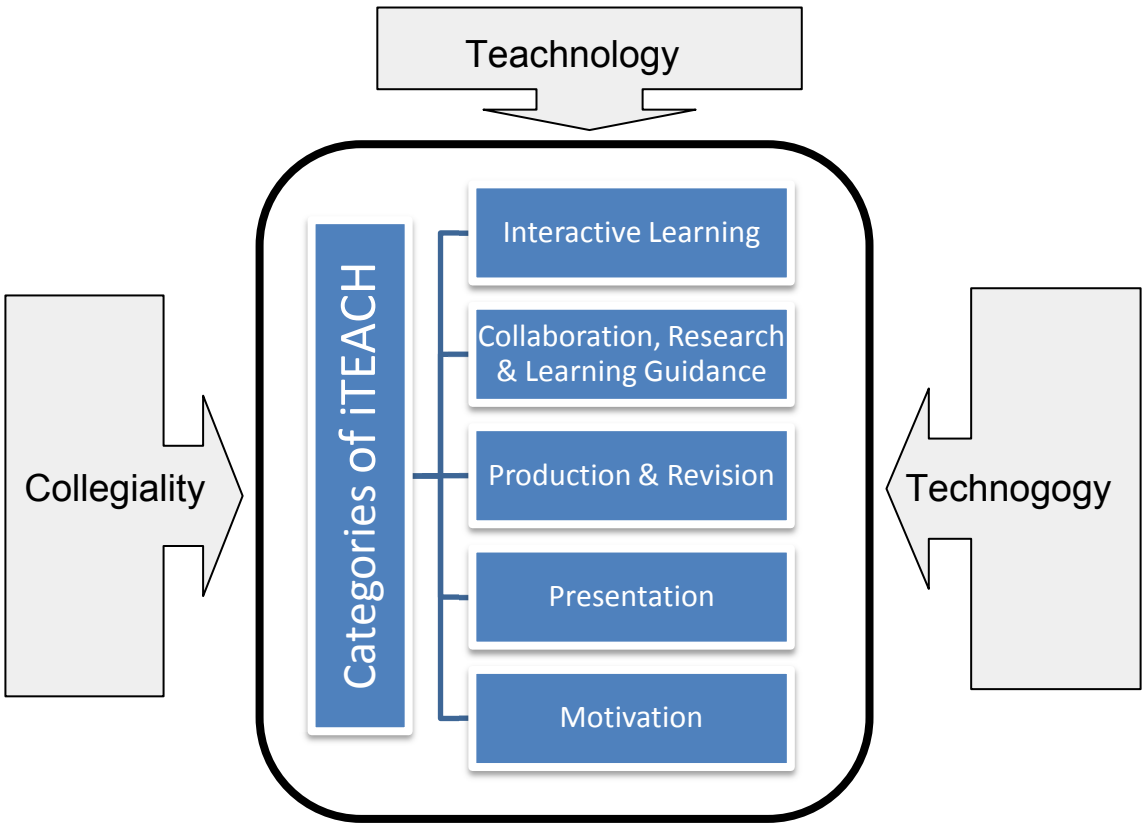


Figure 5.2. The 'iTEACH' Implementation Model

The emphasis of iTEACH Implementation model is on aligning Teachnology, Technogogy and Collegiality based on the category (see Table 5.5) that is targeted.

• Category	• Teachnology	• Technogogy	• Collegiality
• **Category E** • **(Interactive Learning)**	• Interactive games • Computer simulations Research sites	Development and Programming skills User application skills Research skills	To support the development and use of the customised ICT which may involve external curriculum and Teachnology specialists
Category D (Collaboration, Research & Learning Guidance)	Social networking sites Learning portals	Facilitation of discussions Use of social networking sites Guiding the learning process through asking and answering questions, and correcting mistakes	To share ideas on the use of networking sites or online research sites This category may involve cross-department sharing if the same platform (e.g. Blackboard) is used.
Category C (Production and Revision of Work)	Online or technology-based quizzes	Setting up of quizzes Generation of appropriate questions for web-based assessments	To share questions (e.g. evaluate a YouTube video clip)
Category B (Presentation of Information)	Teacher-made video clips PPT slides	Presentation Skills instructional design principles Infusion of non-ICT enabled activities into lesson	To share presentation slides and ideas with each other Within department sharing is sufficient to support this category of ICT use.
Category A (Motivational Learning)	Commercial video or sound clips	Motivational skills Giving advice / counseling skills Require skills and time to select effective resources	To share useful ICT resources found online e.g. YouTube video clips Sharing on an informal level within the department is

			most likely.

Table 5.5. Five Categories of the iTEACH Implementation Model: Across Teachnology, Technogogy and Collegiality

Obviously, within a school with so many teachers, there will be a range of categories being targeted e.g. using ICT to present information and for collaboration. While allowing and encouraging teachers to continue to utilise ICT to achieve the intended purpose, schools may also want to focus on specific categories in order to address certain gaps within their curriculum. For example, if a school determines that her students lack research skills and should be exposed to collaborating with experts online in other countries, Category D (Collaboration, Research & Learning Guidance) could be the focus for the year. Teachers will still continue to use ICT in the other iTEACH categories but, as a result of the school focus for that year, they may also delve into Category D usage and use online forum discussions as a means of enhancing research and interview skills. At the school level, iTEACH Implementation Model can prove to be a strong unifier to focus energies and resources on improving key gaps in the school, so as to achieve specific outcomes for that year.

Using the model, a school may wish to review how these three dimensions behave in its school environment. For example, if a school is targeting a Category D implementation with the use of a learning portal and discussion forum among students, parents, teachers and industry experts but the technogogical expertise among teachers is appropriate for Category A implementation, then this mismatch could result in the teachers not being able to keep up with the available Teachnology, possibly resulting in frustration, resignation and low efficacy. The converse will also be true, if teachers possess technogogical skills at Category D but are forced to adopt motivation plan: Teachnology due to resource constraints. They may also experience frustration at the lack of outlets for innovative expression and professional development.

Correspondingly, different degrees of collegiality are needed to support the various categories of implementation. With Category E Teachnology where interactive learning is expected, the content and student profile play an important in customising the teachnology for use in the local school context. Software programming and

specialised hardware may be necessary to allow for customised interactive learning. Hence, external parties and cross-department teams within the school could form the Collegiality necessary to bring about Category E implementation. On the other hand, for Categories A & B implementation, within-department support and sharing on an informal basis may suffice since the demands are not extremely great and the risks of failure are more manageable. As seen in Cool School's example, the socio-gram revealed mainly within-department interactions with the Principals giving a free rein to the teachers to experiment with innovative ICT practices and this is effective for Categories A and B ICT use.

5.4 Facilitating Teachers to Locate Their Preferred Category of ICT Implementation

At this juncture, it is necessary to emphasise that the iTEaCH Implementation Model can also facilitate the process of ICT implementation for individual teachers. While at the school level, iTEaCH provides a useful 'dashboard' for school administrators to decide where best to allocate resources (i.e. which category to focus on), the model works to inform individual teachers on how best to locate their own technogogical belief, the teachnology they have at their disposal and the collegiality that can support them in school. Having located the current category of ICT implementation, teachers can then determine if they wish to explore other categories and if so, develop or acquire the necessary teachnology, technogogical skills and collegiality to initiate and sustain their use of ICT in the classroom.

By mapping their current strengths and gaps on the iTEaCH model, teachers can better gauge the resources they have and minimise potential risks of failure such as damaging their confidence levels and needing to account to school management for the resources expended.

Similar to using iTEaCH when implementing ICT for the school, iTEaCH Model when applied to individual teacher's professional practice, is self-empowering. It empowers through a profiling process (either of self or school) and addressing potential gaps to ensure that the three dimensions (Teachnology, Technogogy and Collegiality) can support the necessary implementation for the selected category (A to E).

5.5 Addressing Gaps using iTEaCH Model

For teachers with gaps in their Technogogial skills, teacher training is key. The degree that Teachnology is used effectively for learning depends on how well the teacher incorporates the selected Teachnology into the curriculum. As mentioned by Cool School teachers, formal teacher training is somewhat limited although the school relies heavily on the strong Collegiality (e.g. peer sharing) to make up for the low training inputs, in order to build Technogogical expertise.

Teachnology, on the other hand, will range from 'cheap' to 'customised' and hence, are more costly (See Appendix 4 for comparisons between 'cheap' and customised Teachnology). Student-owned ICT such as mobile phones and laptops and 'free' ICT resources such as FaceBook and YouTube video clips place a low resource demand on the school but can require a high level of Technogogical expertise on the part of the teacher. Aligning teacher training with the types of Teachnology available in the school is probably more effective than buying all types of technology or sending teachers for training in all types of technology use, some of which teachers may not even believe in.

The issue of resource utilisation is especially pertinent to private schools. What then is an effective approach to ICT implementation for these schools with few resources? The next section proposes some steps that private schools can consider when implementing ICT measures for classroom teaching.

5.6 Steps to Implementing ICT in Private Commercial Schools

The key tenet of the iTEaCH Implementation Model is that alignment of the three dimensions (Technogogy, Teachnology and Collegiality) to bring about the selected purpose of the ICT use will ensure a more effective utilisation of resources for classroom teaching. Hence, the understanding of the needs of the students (Technogogy), the pedagogical beliefs of teachers and the available Teachnology in the school are crucial to maximising learning effectiveness through ICT use.

Step 1: Profile Students' Needs

Students have needs which differ from school to school. In Cool School, many students have issues with motivation and attention span so understanding how technology can increase motivation is of paramount importance to them. Hence, beginning with students' needs is appropriate as the first step.

Step 2: Determine Teachers' Preferences and Strengths

Secondly, equally crucial is the understanding of teachers' preferences and strengths. For example, if Roger (1995)'s model is used to profile L1, she will be labelled as a laggard since she was much slower than the other teachers in adopting ICT in the classroom. Eventually, even though she adopted an ICT-enabled collaboration approach with blogs, she was still not using presentation slides to teach. In essence, L1 avoided Categories A (motivational) and B (presentational) but chose Categories C (production & revision of work) and D (collaboration) which coincided with her professional values and constructivist beliefs to engage her students in learning. She might have never got on the ICT bandwagon if there were no collaboration-based ICT resources. The case of L1 illustrates that teachers may have a myriad of different perceptions and attitudes, in relation to the levels of ICT use. It is more useful to determine which categories of ICT implementation teachers are comfortable with and provide specific training to equip them with Technogogical skills for those categories.

Step 3: Estimate Current Available ICT Resources

The third step to determine how much Teachnology the school already has and needs is a pragmatic one. If the school already has Category D (Collaboration) Teachnology, then it is logical to work at Category D ICT implementation.

On the other hand, if the school does not have a lot of ICT resources, then starting with one or two categories may be more practical so as to help teachers and the technical support staff to focus on using the relevant ICT to achieve the purposes and learning outcomes of the lesson. Not forgetting that the school culture (Collegiality) will also play a pivotal role in the selection of the category of Teachnology and Technogogy.

Step 4: Ascertain the School Culture

Fullan (2002) emphasises the importance of changing the school culture to bring about sustainable change in mindsets. The open and innovative learning culture in Cool School promotes collegiality which is in essence, peer sharing, innovation and professional security. Teachers can try new ICT or ideas without the fear of being reprimanded. By allowing 'organic growth', Cool School encourages teachers to experiment, and if the new ideas are successful, the School usually turns them into standard practice across the departments.

Step 5: Decide on the Level of ICT Implementation

At step 5, the school decides on the level of ICT implementation to adopt. It may be useful at this point to draw up a general profile of the school in terms of the three dimensions. While the profile may be overly generalised, given the wide variety of teacher Technogogical capability, Collegiality levels and possibly Teachnology availability in the school, it may provide a useful guide for the school management when crafting a technology plan. The profile is essentially a snapshot of the Technogogical skills, Teachnology possessed and Collegiality available to the teachers in the school.

In some schools, targeting specific categories of ICT implementation may not work well especially if the teachers have relatively diverse range of Technogogical skills and Teachnology. Whichever category that the school chooses will result in a high degree of mismatch. In such cases, the school management may want to impute more autonomy to the teachers by allowing them to innovate and use Teachnology based on their comfort level and Technogogical expertise. This approach will avoid stifling the more innovative teachers with pre-prepared Teachnology while teachers who are comfortable with the lower levels of Teachnology can focus on using ICT to motivate or present information. Providing a culture of flexibility, liberty and creativity is key to matching the needs of different types of teachers in the school.

It is important at this stage that the school management adopts specific approaches based on their school ICT profile, emphasising the importance of reviewing the interactions among the three dimensions rather than focusing on any specific dimension separately.

Step 6: Review and Assess Effectiveness of ICT Implementation

The regular reviews conducted in Cool School by the management are driven by the need to constantly engage their students on a daily basis. As these students opt to study as private candidates in Cool School, the temptation to drop out again is very strong so they need to feel that they are making progress and that they can make it to the end. As a result, student's attendance and their feedback ratings on their teachers are treated seriously to maintain the teaching quality and to update the teachers on their teaching approaches. Hence, the role of ICT as a motivational tool is highly relevant here. However, if there is a change in student or teacher profile and a different ICT strategy is required, then the school management should be aware and this is conducted through regular reviews of the technology plan.

The results from the study on Cool School have been used as the basis to formulate these 6 steps. Although the study comprises most of the teachers in Cool School, the number of teachers is still relatively small. However, the study does provide rich data which illustrate the diversity and the interactions of the factors involved in ICT implementation. It is hoped that the 6 steps listed above provide some clarity for the school management when deciding how to go about implementing ICT in schools, especially in a way which takes into account the environment and culture of the school.

5.7 Implications of the iTEaCH Implementation Model

With the iTEaCH Implementation Model, schools are now informed on how they can:

1. target the right type of software and hardware to purchase (e.g. iPad, iPhones) based on the Technogogical skills of teachers in the school
2. recruit teachers with the right level of Technogogical skills for the school
3. develop appropriate school culture for implementation of ICT (e.g. organic growth model)
4. empower teachers to act first and ask for permission later

Keeping the categories of Technogogy and Teachnology in mind, school leaders can select the appropriate approach based on the type of school culture, teacher and student profile and amount of resources available to implement ICT. Like Cool

School, school leaders may allow groups of teachers to adopt other approaches (e.g. Presentational instead of Interactive Learning Teachnology) as ICT 'experiments' for the purpose of organically growing the ICT culture in the school.

5.8 Special Mention of Organic Growth Culture in Cool School

The ICT policy in Cool School has been to allow the system to grow organically i.e. freedom for the teachers to explore and use the ICT that they are comfortable with which is similar to Pospisil & Willcoxson (1998)'s Anarchic Development described in their model.

Often, the technology used is free or available at low cost e.g. FaceBook, YouTube videos and DVDs of movies. Because 'cheap' technology is used, there is little push for teachers to use a particular technology unless it works. Furthermore, teachers have the liberty to try certain technologies and give them up if they do not fit. Hence, having a technology policy that is relatively freed up actually creates an atmosphere of wanting to follow and try rather than having to be forced to try. The school management set a good example of leading by doing, especially in the use of ICT (e.g. MacBook) themselves and getting teachers to share their experiences. The eventual result is a real application of the ICT process, knowing what works and what doesn't for them.

Cool School's 'Organic Growth' strategy is unique and apt, partly due to the financial constraints it faces but also in view of the strong collegiality, the relative young teaching staff and the emphasis on innovative teaching practices by the management. The teachers have adopted ICT in their teaching despite the absence of any annual school ICT budget. The ICT model adopted by Cool School provides some key lessons for other private schools to consider.

5.9 Lessons for Other Private Commercial Schools in Singapore

The following points are distilled from the study for other private schools to consider:

- To encourage ICT use, it is important for ICT to be seen to contribute to overall school results through engaged learning from Categories A to E of Teachnology, Technogogy and Collegiality.
- Teachers should have space to experiment with new technology.
- Organic growth through Web 2.0 and free resources (e.g. FaceBook) reduces the risk of investments and being tied to a single web / ICT resource.
- School leaders should lead by example and share passionately about ICT if they want teachers to catch the same mindset and spirit.
- Instead of spotting potential projects too early, let the projects grow organically. This empowers teachers to try new initiatives without the pressure to deliver and allows discarding of projects if they fail, with little loss to school. e.g. S3 could implement an initiative using video clips and Bluetooth them to her students' mobile phones in class without any prior approval.
- Unlike some schools where students' mobile phones and iPods are prohibited, Cool School utilises the students' technology for learning.

5.10 Limitations of Study

Understandably, this study is a single case and there could be other findings which could have been generated if the study involved another school. A future research study to compare the findings of another school with those from Cool School should be considered.

In addition, among the fifteen teachers in Cool School, one teacher declined to be interviewed while out of the fourteen who participated, four teachers actually responded through written surveys. These written responses while revealing do not provide the richness of face-to-face interviews which comprise clarifications and probing of key points made by teachers.

The use of Cool School as a unique case also means that many of the characteristics may not be found in other private commercial schools and hence, these findings may not be as helpful or generalisable to the other private schools.

Lastly, the effectiveness of ICT-enabled lessons are not measured nor observed, only the teachers' self-reports are used which may result in self-reporting bias. Hence, after collecting the data, I had to scrutinise the data to ensure the teachers were not trying to project an image better than it actually was. My former role as Director of Cool School could also possibly result in some bias in the data.

5.11 Future Research

It will be useful to examine schools adopting the other levels of Teachnology and to determine if there are any additional requirements of such an approach. A separate study can be designed to determine if the different levels of Technogogical skills in a particular school can be easily transferred to teachers in other schools. Will characteristics of teachers affect the transfer process?

It will also be useful to determine if certain levels of Teachnology will be a more effective ICT approach to help students achieve learning objectives n the classroom. A further longitudinal study to track the development of Cool School Teachnology and Technogogical skills will also be a useful follow-up to this study.

5.12 Conclusion

To a large extent, the literature seems to take on uni-dimensional approaches to investigating ICT implementation in schools. Ranging from psychological factors such as *habitus* (Belland, 2009) and teacher resistance (Staples *et al.*, 2005) to school factors such as lack of ICT resources and teacher training (Chapman, 2004) to the culture of collaboration and support among school staff (Fullan, 2002; Slay *et al.*, 2008), there are few studies (e.g. Schussler *et al.*, 2007) which attempt to examine how these cross-dimensional factors interact and influence ICT implementation as a whole. It is unfortunate that most studies remain fixated on single-dimensional treatment when the outcomes are usually determined by the

interactions of various factors (e.g. L1's unwillingness to employ PPT slides as a didactic tool for teaching).

From this study of Cool School, I have attempted to bring out the unique characteristics of the teachers and school management and how a culture of 'organic growth' presents interesting options for school managements to consider. Beyond just consideration of teacher characteristics (Rogers, 1995) and implementation phases (Sandhotlz, 1997), this study recognises the complexity of the interactions among the key factors (Technogolgy, Teachnology and Collegiality). The eventual iTEaCH Implementation Model is a reflection of this complexity.

Private schools are encouraged to craft their technology plan based on their strengths and available resources so as to target specific levels of Technogogical training for teachers and to purchase the appropriate level of Teachnology. By making informed choices, it is believed that the iTEaCH Implementation Model will assist school leaders in making technological inroads in their school's use of ICT in teaching.

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Appendix 1: Letter to Teachers in Cool School

Proposal for ICT Research Study

By Michael Choy

Introduction

As part of my doctorate thesis, I am examining the use of ICT (Info-Communication Technology) in private schools in Singapore. This is one area that has not been studied extensively. Knowing that ____ has a history of using ICT in lessons e.g. use of SmartBoards and video clips etc, I would like to find out your experiences in ICT use. These experiences would help other private schools to implement ICT in their lessons.

Specific Research Questions

Some of the specific areas I would be looking at include:

1) What is the proportion of lessons conducted using ICT in private schools?
2) What are the challenges and obstacles that Singapore private school teachers face in implementing ICT lessons in the classroom?
3) What kinds of help, support and training do these teachers seek for to cope with implementing ICT lessons in school?
4) How are these ICT-based lessons conducted?
5) What motivates private school teachers to use ICT to teach?

The research involves:

- 2 Interviews with individual teachers

These sessions can be conducted at a time and place stipulated by you.

Returns for School

The results of the study would be made available to the schools involved in this research. These results should show the strengths and weaknesses of ICT implementation and how lessons can be made more effective for the students through ICT. It will also provide a model for other non-ICT private schools to follow.

I hope you will spare some time to help me collect the data. Thank you very much!

Michael Choy

Appendix 2: **Interview Questions – Teachers**

Questions	Responses
Demographics	
1. May I ask for your age? Gender?	
2. How many years have you taught? At which level?	
3. May I ask if you have any children of your own? Married?	
4. What are some of the schools you taught in? Were they boys, girls or mixed gender schools?	
5. Were you trained in NIE? When was that? Was there any IT course during your NIE days?	
6. Have you ever held an appointment e.g. HOD? What appointment are you holding now?	
7. When was the first time you came into contact with using IT in your life (regardless for teaching or not)?	
Usage	
8. Do you use ICT every day? What kinds? How?	
9. What are some ICT that you use them for daily?	
10. When did you start using ICT in your life? Why?	
11. Are there any bad experiences with ICT use?	
12. How did these bad experiences affect your usage of ICT now?	
13. Who taught you how to use ICT? Was it more of a hands-on or theory? How did you follow up with that training?	
14. How often do you use ICT in your classroom teaching e.g. PPT slides? Interactive games or individual hands-on?	
15. In what other ways do you use ICT in the classroom?	
16. In what ways do you feel that the students are engaged during ICT usage? How long are they engaged for?	
17. Are there any specific subjects or topics that you use ICT?	
18. Which part of the lesson do you use ICT most? E.g. introduction? Main	

lesson? Discussion? End of lesson?	
19. What are some key considerations you would make when planning a lesson with ICT usage?	
20. Which is more difficult for you - carrying out cooperative learning strategies or utilizing ICT for classroom teaching?	
21. What are some of your concerns when carrying out a lesson involving ICT? E.g. classroom management? Disruptive beh/not-on-task? Surfing unintended sites?	
School Culture	
22. What kinds of support do you get from a) colleagues b) superiors (e.g. IT HOD) c) technical staff?	
23. What kinds of support are you looking for from a) colleagues b) superiors (e.g. IT HOD) c) technical staff?	
Attitudes & Temperaments	
24. How do you feel about the use of ICT in teaching? Any advantages or disadvantages?	
25. Compared to traditional teaching methods such as using chalk and board, how do you think ICT benefits the learning process?	
26. In what other ways does ICT help the children?	
27. How would you define an ICT lesson? – using LCD Projector in place of Blackboard? Use of interactive software? Hands-on for all children?	
28. What do you think is the best and most effective approach for ICT use in the classroom? Are you doing that? Why? How often?	
29. Do you feel that you are skilled in ICT use? Knowledgeable about ICT?	
30. Are you confident using ICT in the classroom? In your personal life? Are you motivated to use ICT in your teaching?	
31. What are some of the concerns or problems you have about using ICT in the classroom? How did you cope with	

the school's initiatives?	
32. On a scale of 1 to 10, how would you rate yourself in terms of motivation towards using ICT in the classroom? '1' is very poor while '10' is very good. Are there any reasons for this rating?	
33. What stage in your career would you define yourself to be in? Are you happy? Comfortable? Cruise mode?	
34. What is your current priority? Family, Career, Religion? Other activities?	
35. What is your temperament like? Are you usually more easy-going or more task-oriented?	
36. Do you believe that the majority of the classroom activities should be tr-centred or student-centered? Why?	
37. How does ICT fit into the overall pedagogical framework? Are you able to adopt such an approach?	
38. Are you competent with incorporating simpler ICT tools (such as PowerPoint) into your teaching for an effective lesson? Why? Rate yourself from '1' to '10' with '1' as not competent at all and '10' as very competent.	
39. Do you consider yourself competent at using the newer and innovative ICT tools (such as PDAs) in your teaching for an effective lesson? Why? Rate yourself from '1' to '10' with '1' as not comfortable at all and '10' as very comfortable.	
40. If given a choice, what would you focus on - improving the way (process / pedagogy) you use ICT technology in the lesson or learning new ICT hardware or software (product) to incorporate into the lesson?	
41. Why would you use or not use ICT in your classroom teaching? Do you feel that it take up too much of your energy and time to teaching using ICT?	
42. Do you see the ICT initiative as similar to other changes implemented by schools? Do you respond to them in the same way?	
43. How are teachers' resignations from the service related to these changes? Is there anything we can do to reduce the	

attrition rate of teachers?	
44. Comparing private and government schools, do you see any difference between the two in terms of how ICT is used?	
45. Are there any processes in CHEC that facilitate the implementation of ICT lessons e.g. sharing among teachers or ICT support?	
46. Are teachers expected to carry out a certain number of ICT lessons per term?	
47. Do you have a ICT mentor to help you plan and carry out lessons using ICT?	
48. Do you feel you have sufficient ICT training? In what areas do you need it?	
49. How are students using ICT to present their work or to do research?	

Appendix 3: **Interview & Survey on Use of ICT in Schools**

Write down the names of 5 people in Cool School you communicate **most** with on the use of technology in your classroom on a **TYPICAL school week**. Indicate how and what you communicated specifically about.

	Names	**How?**	**How Often? / week**	**How Long? (min)**	**What about?**
	E.g. YYY	Chatting	4 times	30 min & 10 min	□ Trouble shooting of ICT equipment □ Discuss use of blog for teaching □ Ask for opinion on suitability of video clip
		Email	Twice	-	
		Meetings	Once for staff meeting	15	
		Phone calls	Twice	10 min each	
		Others: Written notes	Once	-	
1		Chatting			
		Email			
		Meetings			
		Phone calls			
		Others: Written notes			
2		Chatting			
		Email			
		Meetings			
		Phone calls			
		Others: Written notes			
3		Chatting			
		Email			
		Meetings			
		Phone calls			
		Others: Written notes			

4		Chatting			
		Email			
		Meetings			
		Phone calls			
		Others: Written notes			
5		Chatting			
		Email			
		Meetings			
		Phone calls			
		Others: Written notes			

- Describe an ICT (technology) project that you are currently working on:

  _____

  _____

- State the people involved in the project:

  _____

Appendix 4: **Comparisons Between Cheap and Customised Teachnology**.

	Cheap Teachnology	Customised Teachnology
Approach	Beginning with available, free or cheap technology, teachers build lessons around these available ICT resources. The downside is that there may not be many suitable resources (e.g. video clips on secondary school Mathematics) and most of these resources provide auditory and visual inputs.	Beginning with the learning objectives of the curriculum, teachers attempt to locate technology which would lend itself well to the lesson. To customise technology to curriculum objectives, teachers make the ICT resources themselves or get the students to do it. Both of these are very expensive and time-consuming.
Resources Required	Generally low cost Resources are already available: • Online software or websites e.g. FaceBook, YouTube clips • Students already have them e.g. mobile phones or laptops	Generally high cost Requires: • Programming ICT to match curriculum requirements • ICT equipment for individual students e.g. laptops or iPads
Advantages	• Cheap technology • Less pressure on teachers to use the technology • Students are familiar with the technology or the resource e.g. FaceBook and blogs • Relevance for students • Fast adoption • Less planning required • Quick results • Technology can be abandoned quickly when it becomes obsolete or if it fails • Teacher ownership • Sharing with other teachers is simple due to the use of familiar technology	• Facilitates the achievement of more difficult learning objectives • Fits the curriculum • Allows large-scale implementation • Acts as a multiplier or catalyst to upscale ICT-enabled lessons

	Cheap Teachnology	Customised Teachnology
Disadvantages	• Piecemeal interventions which may not lead to large scale implementation • Require supplementing through constructivist strategies such as group work or discussions • Time-consuming searches by teachers to find appropriate resources e.g. video clips	• Expensive • Teachers are forced to use the resources • Takes time to develop which may result in outdated ICT • Training of teachers and students required • High risk and cost investment if intervention fails • Requires additional step of convincing teachers to use since ownership is with the curriculum or technology specialists
Persons driving change	Individual classroom teachers	Technology and curriculum specialists with cooperation of school management