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Tablet PC use in teaching and learning : a case study

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TABLET PC USE IN TEACHING AND LEARNING: A CASE STUDY

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B.A. (Uni of SA), Dip. Ed. (LaTrobe)**

**This thesis is presented in partial fulfilment of the requirements for the degree of
Master of Education**

**Faculty of Education
Edith Cowan University**

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ABSTRACT

With the emergence of the use of the traditional (non-touch screen) notebook computer in the classroom, different teaching styles and equipment have been introduced. Teachers have started to use the Notebook PC to support their teaching. They now have the ability to gather and use a far greater range of materials in the classroom with little distraction.

The introduction of the touch screen Tablet PC has brought another dimension to the way technology can be used in the classroom. This study seeks to investigate the ways in which Tablet PC technology has been used to enhance the learning of students within the classroom and how that differs from that of the traditional notebook.

The purpose of this study was to look at ways in which the Tablet PC technology was being used in a specific school setting. It looked at how teachers used the Tablet PC in a classroom environment; investigated what unique features of the Tablet PC were being utilised; and for what purposes specific features were being used. It looked at how classroom dynamics changed; the physical look and feel of the classroom; as well as the changes in pedagogies around the use of the Tablet PC. Additionally, the study looked at teacher/student and student/student interactions as a result of the use of the Tablet PC.

The study concluded that the Tablet PC was implemented with some success, within the selected school, and a number of unique features were used. The results suggested that in particular circumstances the dynamics of the classroom changed for the better as did classroom setup, pedagogies and interactions between students and teachers. The study found that there were a number of key indicators that needed to be improved before a Tablet PC program could become successful. These included: increased Professional Development for teachers around the use of the Tablet PC in the classroom; increased time allocation for teachers to investigate and create learning activities; improvements in the school's infrastructure and quality of the students' Tablet PCs. The study also recommended that once the key indicators have been met, another study

into the use of the Tablet PC in a school setting should be conducted. This should be able to give a far greater indication of the role the Tablet PC has in education.

DECLARATION

I certify that this thesis does not, to the best of my knowledge and belief:

- (i) incorporate without acknowledgment any material previously submitted for a degree or diploma in any institution of higher education.
- (ii) contain any material previously published or written by another person except where due reference is made in the text; or
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The completion of this study was only made possible with the support and encouragement of a number of people.

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My sincere thanks are also extended to my supervisors Dr Jeremy Pagram and Ass Prof Paul Newhouse; their expertise, knowledge, guidance and especially their patience has been so appreciated.

I would also like to thank all the teachers that gave up their time to assist in the completion of the questionnaires and interviews; their valuable knowledge assisted in the completion of this thesis.

TABLE OF CONTENTS

USE OF THESIS	ii
ABSTRACT	iii
DECLARATION	v
ACKNOWLEDGEMENTS	v
LIST OF TABLES	x
LIST OF FIGURES	xi
CHAPTER 1 INTRODUCTION TO THE STUDY	1
Introduction	2
Problem Statement	3
Significance of the study	3
Purpose of the study	4
Research Question	4
Organisation of this thesis	5
List of key terms and definitions used in study	6
Summary	10
CHAPTER 2 LITERATURE REVIEW	11
Introduction	12
Case Studies reviewed from literature	12
The Tablet PC used in this research	13
Infrastructure	14
Opportunities for Tablet PCs and ICT	14
How can a Tablet PC enhance teaching and learning?	16
Students using Tablet PCs	16
Teachers using Tablet PCs	18
Advantages of the Tablet PC over a traditional Notebook	22
Limitations of a Tablet PC	24
Tablet PC unique features and software	25
Improved ICT skills	26
Pedagogies/New teaching styles	27
Classroom setup and implementation	28
Mobility	29
Conceptual Framework	29
Summary	30
CHAPTER 3 RESEARCH METHODOLOGY	31
Introduction	32
Re-statement of the research question	32
Research design	35
Sample selection and role of researcher	35
Research setting	36
Data collection	38
Questionnaires	38
Interviews	38
Classroom observations	39
Field notes	40
Data analysis	40

Ethical considerations	40
Summary	40
CHAPTER 4 RESULTS AND DISCUSSION	42
Results from the teacher questionnaires	43
Features of the Tablet PC being used in classrooms.....	47
Interaction.....	51
Pedagogies being used with the Tablet PC	53
Issues with Technology	58
Conclusion	59
Teacher Interviews.....	61
Case Studies	63
Case Study 1 Early Adopter (Jon)	64
Background.....	64
Classroom setup	64
Implementation of lessons.....	65
Sample lessons	67
Features of Tablet PC	69
Interaction - Teacher/Student.....	71
Interaction - Student/Student.....	71
Pedagogies being used with the Tablet PC	72
Issues with the technology.....	73
Future use of the technology	74
Summary	74
Case Study 2 Late Adopter (Barry)	75
Background.....	75
Classroom setup	75
Implementation of lessons.....	76
Features of the Tablet PC.....	77
Interaction - Teacher/Student.....	77
Interaction - Student/Student.....	77
Pedagogies being used with the Tablet PC	78
Issues with the technology.....	79
Future use of the technology	80
Summary	81
Case Study 3 Reluctant Adopters (Gayle)	81
Background.....	81
Classroom setup	81
Implementation of lessons.....	82
Features of the Tablet PC.....	83
Interaction - Teacher/Student.....	83
Interaction - Student/Student.....	83
Pedagogies being used with the Tablet PC	84
Issues with the technology.....	84
Future use of the technology	85
Summary	85
Cross-Case Findings.....	86
Background.....	86
Classroom setup	86
Implementation of lessons.....	86

Features of Tablet PC	88
Pedagogies being used with the Tablet PC	89
Interaction - Teacher/Student.....	90
Interaction - Student/Student.....	90
Issues with the technology.....	91
Future use of the technology	92
General comments	92
Summary of common trends across all areas	93
Discussion.....	93
Tablet PC unique features and software.....	94
Improved ICT Skills	94
Pedagogies/New teaching styles.....	95
Classroom setup and implementation	96
Mobility	96
Summary of findings	97
Setup of the classroom.....	97
Implementation of lessons.....	97
Features of Tablet PC being used by teachers	97
Pedagogies being used with Tablet PCs	97
Interaction	98
CHAPTER 5 CONCLUSION	99
Overview of the study.....	100
Research Findings.....	100
Setup of the classroom.....	100
Implementation of lessons.....	101
Features of the Tablet PC being used by teachers.....	101
Pedagogies being used with the Tablet PCs.....	101
Interaction between students and teachers.....	102
Interaction between students and students.....	102
General Findings.....	102
Implications	104
Limitations of the Study	104
Recommendations for future research.....	105
REFERENCES	106
APPENDICES	110
Appendix A: Experience of Change (EoC) Instrument	111
Appendix B: Teacher Questionnaire	114
Appendix C: Staff member interview consent form	120
Appendix D: Sample PowerPoint Presentation from students in one of Barry's lessons.....	121
Appendix E: Formative Assessment and Mini Whiteboards.....	123

LIST OF TABLES

Table 4.1. Student use of Tablet PC in teacher classes.....	52
Table 4.2. What students used the Tablet PC for	53
Table 4.3. Frequency of outcomes evident when Tablet PC was used	54
Table 4.4. Participants' demographics.....	61
Table 4.5. Common issues arising from EoC Interviews	62
Table 4.6. Teachers EoC score between -20 and +20	62

LIST OF FIGURES

Figure 1.1. The Tablet PC	6
Figure 2.1. Conceptual framework used in the study.....	30
Figure 3.1. Research question, data sources and methods of analysis	34
Figure 3.2. Research design framework.....	35
Figure 4.1. Years of teaching experience	43
Figure 4.2. Teacher’s description of their perceived use of learning technologies (Question 11).....	44
Figure 4.3. Teachers perceived views on how they use technology to support student learning (Question 12)	45
Figure 4.4. Staff perceived ICT skills (Question 15).....	46
Figure 4.5. Frequency of use of subject-related strategies as indicated by teachers (Question 13).....	46
Figure 4.6. Software frequency use indicated by the teachers for various software types (Question 14).....	47
Figure 4.7. Learning activities that students used with Tablet PC (Question 6a).....	48
Figure 4.8. Expected added value from students using the Tablet PC (Question 6b)	49
Figure 4.9. Future use of the Tablet PC (Question 6e).....	49
Figure 4.10. The most effective use of the Tablet PC in the classroom (Question 6d) ..	50
Figure 4.11. Tasks that are simpler to complete when using a Tablet PC (Question 6f)	51
Figure 4.12. Teacher feelings when supporting students using Tablet PCs (Question 4)	52
Figure 4.13. How the teacher decided when to use the Tablet PC to support learning (Question 6c).....	55
Figure 4.14. Staff changes to their teaching style as a result of teacher having a Tablet PC (Question 9a).....	55
Figure 4.15. Staff changes to teaching style as a result of both teacher and students having Tablet PCs (Question 9b)	56
Figure 4.16. Teaching style changes as a result of staff having a Tablet PC (Question 9a)	56
Figure 4.17. Teaching styles changed as a result of both teachers and students having a Tablet PC (Question 9b)	57
Figure 4.18. Does the teacher contribute to Tablet PC created planning? (Question 10)	58
Figure 4.19. Issues that prevented effective use of the Tablet PC (Question 6g)	58
Figure 4.20. Typical setup of Jon's classroom.....	64
Figure 4.21. Sample screen shot of a student’s notebook in Microsoft OneNote	66
Figure 4.22. Sample of what Jon saw in his own Microsoft OneNote application	67
Figure 4.23. Multiple choice question created in DyKnow	68
Figure 4.24. Screen shot of DyKnow’s polling feature	69

Figure 4.25. Sample screen shot of students work in Microsoft OneNote 70
Figure 4.26. Typical setup of Barry's classroom..... 76
Figure 4.27. Typical setup for Gayle's classrooms 82
Figure 4.28. Conceptual framework of the study 93

CHAPTER 1

INTRODUCTION TO THE STUDY

Overview

This chapter describes the purpose and context of the study. It outlines the need for the study and its significance. It describes the research question and the purpose of the study as well as key terms and definitions used throughout the study.

Introduction

The concept of a portable computer being used in a classroom has been around for several decades now. The first portable Notebook-sized computers were introduced to the market place in the late 1980s and by the mid-1990s were being introduced into schools, initially mainly as class sets that could be booked for use, similar to that of a desktop lab setting; however, in some schools each student had one (e.g. Loader, 1993). As schools began to realise the potential for learning with a Notebook, 1:1 computer to student programs were introduced. These schools realised the 1:1 computer programs led to changes in pedagogy, as suggested by Donovan, Hartley, & Strudler (cited in Larkin, 2011, p. 2), Mouza (2008) and Rockman (2003).

While pen or hand recognition computers have been around for nearly as long as the portable Notebook, it was not until 2002 when Microsoft introduced the "Tablet PC", that "digital ink" Notebooks became popular and were recognised for their potential use as a very powerful learning tool in the classroom. The term "Tablet PC" was coined by Microsoft when it released its Windows XP Tablet PC operating system. Consequently, an official Microsoft Tablet PC is essentially "a Notebook computer with a touch or pen enabled screen (digitizer) running Windows XP Tablet PC Edition or Windows Vista" (Van Mantgem, 2008, p.10).

A number of schools have been using the Tablet PC since its inception in 2002. Twining, Evans, Cook, Ralston, and Selwood (2005) stated "the College had been using Tablet PCs since October 2002, with the main purchases taking place in the summer of 2003" (p. 45). Each year more schools are introducing a Tablet PC program. In 2006 the school in which the research took place trialled 15 Toshiba M200 Tablet PCs with their staff and in 2007 introduced the Toshiba M400 Tablet PC as an option for their students. The uptake was so impressive (85%) that in 2008, the school implemented the Tablet PC as the Notebook computer to purchase.

Twining et al. (2005) also suggested that schools in their study were either moving away from their traditional Notebook program or, if starting a Notebook program for the first time, implementing the Tablet PC as their primary choice of machine. While

touch devices such as the iPad and Android tablet are now beginning to be used in an educational context, they were not included, as they were outside the scope of this study, which only looked at Tablet PCs running pre Microsoft Windows 8 operating systems. These devices were not used in the school environment where the study took place and at the commencement of this study they were not available at the time of the research.

Problem Statement

With the large amount of time and resources committed to the set-up and maintenance of a Tablet PC program, the questions to be answered are; do they really make a difference to the learning outcomes of our students? Are the benefits worth the effort and expense in running a program such as this?

Significance of the study

Since the introduction of the traditional Notebook in education in the early 1990s, educators have been asking questions about the impact of a traditional Notebook program (Larkin, 2011; Rockman ET AL, 1997). Does a traditional Notebook really make a difference in the learning outcomes of the students? Significant time, cost and effort have to be put in place to setup a traditional Notebook program. It is not as simple as buying the machines and giving them to the students to use. There are a number of factors that affect how a program will run: network points or wireless access points so that the students can access the internet and the school's intranet; power points in the classrooms so that the machines can be powered if they run out of battery; fixed data projectors for ease of displaying information; and appropriate technical support to be able to maintain the machines. Other factors associated with the devices were highlighted by Bateman and Oakley (2009) when they stated that "whilst the 1:1 device was considered to be sturdy, compact and light, which added to its flexibility, portability and security, its slow start-up time, limited battery life and insufficient memory capacity were drawbacks" (p. 8). These are all important factors that need to be considered when implementing a traditional Notebook program.

With the introduction of the Tablet PC, the use and expected results in child learning have increased. School administrations have expected to see significant improvements in student learning as a result of the increased costs associated with upgrading to the Tablet PC from a traditional Notebook program or the introduction of a Tablet PC program.

Purpose of the study

The purpose of this study was to look at ways in which the Tablet PC technology was being used in a specific school setting. It looked at how teachers used the Tablet PC in a classroom environment; investigated what unique features of the Tablet PC were being utilised; and what exactly these features were being used for. It looked at how classroom dynamics changed; the physical look and feel of the classroom; as well as the changes in pedagogies around the use of the Tablet PC. Additionally, the study looked at teacher/student and student/student interactions with the use of the Tablet PC.

Research Question

The research question to be answered (contextualised within the school in which the researcher works) was: What effect on teaching and learning activities does using Tablet PCs have in Year 5 to 9 classrooms?

The following factors were examined in answering this question:

- Setup of the classroom
- Implementation of lessons
- Features of Tablet PC being used by teachers
- Pedagogies being used with Tablet PCs
- Interaction between
 - Students and Teachers
 - Students and Students

Organisation of this thesis

Chapter One examines the context in which the study was completed. The chapter outlines the need for the study and its significance within an independent school of Victoria. It poses the research question and the exact purpose of the study as well as describing key terms and definitions used throughout the study.

Chapter Two reviews and presents the literature that relates to the purpose of the study. It looks at what a Tablet PC is; the infrastructure involved in setting up and maintaining a Tablet PC program; the advantages of a Tablet PC over the traditional Notebook; the limitation of the Tablet PC; the software being used; and finally how a Tablet PC can assist in teaching and learning.

Chapter Three outlines the research methodologies as well as the instruments used in the study. It discusses the methodologies used in the research, including the design, the sample selection, research setting data collection and analysis, as well as the limitations of the study.

Chapter Four discusses and analyses in detail the results from the data collection. Chapter Five highlights the findings from the study and draws conclusions from these findings.

List of key terms and definitions used in study

Specifications of the Tablet PC used at the time of research:

Toshiba M700: CPU: Intel Core 2 Duo P8700, Operating System: Genuine Windows Vista 32 Bit, Screen Size: 12.1" WXGA TFT Active Matrix 200 CSV 200NIT LED Backlight Display (1280 x 800), Memory: 2GB DDR2, Storage: 128GB Solid State, Graphics: Intel Graphics Media Accelerator (see Figure 1.1).



Figure 1.1. The Tablet PC

Notebook Computer

This is a portable personal computer that has similar components to a desktop computer but is usually a lot smaller. Notebook computers are sometimes called laptops.

Tablet PC

Tablet PCs are fully functional Notebooks running an enhanced version of Microsoft Windows. The Tablet PC allows users, through the use of a pen, to write and draw directly onto the screen using 'digital ink', mimicking pen and paper. Applications allow handwriting to be saved, edited, indexed and searched, giving pen input equal status to the keyboard and mouse.

Convertible

This is a type of Tablet PC that resembles a traditional Notebook; they have all the accessories that a typical Notebook would have, with the additional Tablet PC features. The screen can either slide or twist into the slate position.

Slate

This is a Tablet PC without any form of keyboard or DVD drive; a keyboard can be connected via USB or docking connection at the bottom of the slate device. They are a lot thinner and lighter than a convertible Tablet PC and usually have a lesser battery life than the Tablet PC.

Use of Pen

This involves a specially designed pen used on the screen of the Tablet PC; the pen replicates the controls of a mouse. The Pen has the ability to left and right click and move objects around the screen the same as a mouse. Also used like a real pen, it has the ability to write electronically on the computer screen.

Inking

This involves a specially designed pen to write on the screen of the Tablet PC. The actual writing on the page is called “inking” as it leaves marks on the page of the software that look very similar to that of a pen on a piece of paper.

Tablet Mode

This is when the Tablet PC is placed flat, with the screen facing upwards so that the user can use the pen on the screen. If a keyboard is present, it is usually hidden under the screen.

Notebook Mode

The Tablet PC is placed in a traditional Notebook mode, the screen at a 90 degree angle to the keyboard.

Microsoft OneNote

This is software that assists a teacher or student in gathering information and allows for multi-user collaboration. With the use of Microsoft OneNote, teachers and students gather users' notes

(handwritten or typed), drawings, screen clippings and audio. Microsoft OneNote saves pages in folders called “Notebooks”; in short, it is a digital Notebook. Within the Notebook, there are folders, sections, pages, and sub-pages.

Main Features:

Organisation: It can create Notebooks that include different sections like a teacher’s classes. Each Notebook can be broken down to a section of a teacher’s curriculum or student work.

Research: It can capture and save text, images, video and audio notes in one secure place.

Collaborations: It has the ability to share Notebooks with others; teachers can share a Notebook and students can then collaborate with each other on a solution.

DyKnow

This is classroom management software that facilitates content delivery and collaboration. There are two parts to this software, DyKnow Monitor and DyKnow Vision.

DyKnow Monitor supports tasks like:

- **Attendance:** Student rolls could be marked.
- **Blocking non-curricular applications and URLs.** It allows students to use selected white listed applications and URLs. These are a list of applications and URLs that the teacher has selected to be used by the students.
- **Monitoring students’ screens in real time.** This could be done on either an individual student or the whole class.
- **Transferring files to students’ computers.**

DyKnow Vision supports tasks like:

- Allowing for shared control of students' and teacher's computers.
- Temporarily giving students control of the computer screen.
- Allowing the teacher to either manually or randomly assign students to groups for screen sharing.

Polling – allows students to respond to Multiple Choice questions. The students give an answer and the teacher gets the results straight away; results are displayed as graphs.

Student status – students can indicate their understanding by a green yellow red analogy. The colours indicate the following to the teacher, green fully understand what the key concepts are; yellow has some understanding of what the key concepts are but need some assistance and red has no idea as to what the key concepts are. This information is only visible to the teacher.

Panel collection – allows the teacher to collect student work, either automatically or by students submitting individual panes.

Follow me – gives the teacher the ability to make the students' screens display exactly what the teacher wants.

Chat – allows students to chat with each other or only the teacher.

Outbox

Each staff member at the school has their own storage space on the school servers. Part of the space is an Outbox; other staff and students have access to this space (folder). The staff member, who owns the folder, uses it to place files in that they want other staff and students to gain access to. Other staff and students then gain access to the files, via opening, copying or dragging the file(s) to another location.

Inbox

Staff and students at the school have their own storage space on the school's servers. Part of this space is an Inbox (storage folder). This Inbox folder is used as a shared space; other staff and students submit files to the teacher, via this folder. This is used by staff to accept student work and to place student work in the students' own Inbox folders.

Summary

This chapter has established the context in which the research will occur, it provided information on why there is a need for this study and its significances. The research question was introduced and the purpose of the study was explained, as was a number of key terms and definitions that are used throughout the study. The next chapter discusses reviews and presents the literature that relates to the purpose of the study. It looks at what a Tablet PC is; the infrastructure involved in setting up and maintaining a Tablet PC program; the advantages of a Tablet PC over the traditional Notebook; the limitation of the Tablet PC, the software being used; and finally how a Tablet PC can enhance teaching and learning.

CHAPTER 2

LITERATURE REVIEW

Overview

This chapter presents the literature relevant to the purpose of the study. It looks at what a Tablet PC is; the infrastructure involved in setting up and maintaining a Tablet PC program; the advantages of a Tablet PC over the traditional Notebook; the limitation of the Tablet PC; the software being used; as well as how a Tablet PC can enhance teaching and learning. Finally it concludes with a summary of how the present literature relates to the study.

Introduction

This literature review examines the current literature pertaining to the use of Information Communication Technologies (ICT), specifically Tablet PCs, within schools and classrooms. It includes the literature comparing traditional Notebooks and Tablet PCs; the advantages and disadvantages of both within a school environment; as well as how the technology is being used by both students and teachers.

This review includes:

- Case studies reviewed from literature
- The Tablet PC used in this research
- Infrastructure
- Opportunities for Tablet PCs and ICT
- How a Tablet PC can enhance teaching and learning
- Students using Tablet PCs
- Teachers using Tablet PCs
- Advantages of the Tablet PC over a traditional Notebook
- Limitations of Tablet PCs
- Software for the Tablet PC
- Conceptual Framework
- Summary

Case Studies reviewed from literature

The case studies that were reviewed included a mixture of primary and secondary schools as well as universities. These schools were mainly from the USA, UK and Australia. There was a combination of schools that were implementing ICT and Notebook/Tablet PC programs for the first time, where others had been using some form of program for a while and were upgrading to Tablet PCs.

Some studies reviewed stated that they were implementing the technology for the first time; they had not previously used any ICT in the classroom. They had no first-hand knowledge of what a Notebook or Tablet PC could do, therefore a number of

statements made could quite easily be true for other forms of computers. As suggested by Newhouse (2005) “in many cases claims made for the Tablet PC are simply restatements of claims made about the use of any computers to support learning” (p. 2).

However, there were a few case studies that had already implemented a Notebook program; Frankston High school started the transition from Notebooks to Tablet PCs in 2006 after having a fully integrated Notebook program since 1995. Frankston High School believed the absence of pen functionality with traditional Notebooks hindered their usefulness in the classroom. The school wanted technology that would give teachers even more resources and further increase student engagement and as a result introduced Tablet PCs at Year 7 (Toshiba, 2010).

The Tablet PC used in this research

The Tablet PCs used in the study were fully functional Notebooks running an enhanced version of Microsoft Windows. The Tablet PC allowed users, through the use of the pen, to write and draw directly onto the screen using “digital ink”, mimicking pen and paper. Applications allowed handwriting to be saved, edited, indexed and searched, giving pen input equal status to the keyboard and mouse.

The uses of the pen can be summarised as follows:

- The pen can be used instead of a mouse and is capable of performing “left” and “right” clicks.
- The pen can be used to input text in place of a traditional keyboard.
- Some applications support rich “digital ink” that can be saved, searched, edited and formatted.

There are two types of Tablet PCs, convertibles and slates. While the Slate style is very lightweight and portable, its lack of keyboard and DVD facilities make it less suitable for the young students in the classroom. Microsoft Corporation (2005) in its research stated that:

The slate models typically require an external CD drive in addition to the keyboard and docking station, which just doesn't fit into the lifestyle of an 18-year-old student," says Nicole Chittenden, Information Technology Manager for The University of Vermont School of Business Administration. "The students we polled preferred the integrated keyboard and CD drive, and the flexibility to alternate between slate and laptop modes. (p. 3)

At the beginning of this research, the recommendation from most institutions was the convertible style of the Tablet PC, but with the technology changing rapidly and the introduction of Microsoft Windows 8, more and more institutions are leaning towards the smaller slate devices (Boy & Motteram, 2013).

Infrastructure

Many schools and universities rearranged a number of learning spaces to cater for the new Tablet PC technology. This included freeing up rooms previously configured with traditional ICT hardware as well as fitting out classrooms, like art rooms and school gyms, with data projectors and wireless access points (Sheehy, Kukulska-Hulme, Twining, Evans, Cook & Jelfs, 2005).

Two types of Notebook programs were identified. One was a 1:1 Notebook program, where every student had their own Notebook, which was taken to each class. These machines were either purchased by the students or rented to the students via the school (Twining et al. 2005). The other type of program used banks of computers on trolleys. These were class sets of machines that teachers would use with various classes. These were purchased by the school (Warren, 2012).

Opportunities for Tablet PCs and ICT

Much research reflected that schools that had been introduced to the Tablet PC technology with no prior experience in the use of Notebooks in schools, would not have realised that many of their stated advantages of their programs would also be evident in a traditional Notebook program. Both Kosheleva, Rusch and Loudina (2006) and Twining et al. (2005) found that for schools that were implementing a Tablet PC program, without previously having Notebooks in the school, stated advantages that could have been for either the Tablet PC or a traditional Notebook.

There were found to be a number of advantages of having ICT implemented into the institutions and having the presence of a Tablet PC/Notebook program. Key factors that were identified were: reduction of time in preparing lessons; enhancement of the teaching of literacy and numeracy; enhancement of teacher planning and administration; ease of use in displaying previously covered material that would normally have been erased on a blackboard; no messy chalk or nasty fumes from dry erase markers; greater student motivation since the introduction of ICT and Tablet PCs into the curriculum. Newhouse, Williams and Pearson (2006) state that:

The computers quickly became part of their lifestyle for many students, rather than just a tool to use in completing assignments. The convenience of working on projects at any time and place was a significant advantage to the many students who were juggling family, work and study commitments. (para. 24)

Many schools noted student engagement had increased with the use of the Tablet PC in the classroom. They recognised that ICT was now easily integrated into the curriculum; staff had stopped delivering the “one off” ICT lessons and there was no need for staff to book the IT lab once a week. Twining et al. (2005) wrote that:

Discrete ICT is becoming a thing of the past, as staff begin to realise the importance of embedding ICT skills into other areas of the curriculum. Spreadsheets are used to support the teaching of Maths, Science, History, Geography etc – not as old standalone spreadsheet activities that bear no link to real-life application. (p. 8)

Teachers in many of the schools commented on the way in which the teaching of ICT had become an integral part of their teaching, in one case, as stated by Twining et al. (2005) “doing away with the need for discrete ICT lessons” (p. 7). The Tablet PC had an effect when learning took place, by extending learning outside formal teaching sessions.

Teachers had access to a wider range of resources than they had previously had. For example, they could access new material, websites, and multimedia resources live in the classroom. Microsoft Corporation (2011a) believes that teachers now have a far greater repertoire of teaching resources available to them. The Tablet PC has

enhanced teaching and learning at a greater rate than was possible with the distribution of desktop computers in traditional classrooms. A report from Microsoft Corporation (2011a) states that, “Students and teachers often only want access to online materials for a few minutes at a time during classes. It doesn’t make sense to occupy computer classrooms that are in high demand just for intermittent use” (p. 2).

Coe and Preist (2004) acknowledge that due to the introduction of ICT into the school, teachers had reported making changes to their teaching style; teachers were planning more interactive and creative opportunities for their students. They also stated that, “the use of ICT in teaching across the curriculum had become second nature. Teachers saw ICT as just another tool” (p. 12).

How can a Tablet PC enhance teaching and learning?

The technology embedded in a Tablet PC is far more intuitive than a traditional Notebook. Ifenthaler and Schweinbenz (2013) state that, “from an instructional point of view beneficial features of Tablet PCs range from the availability of tools such as simulations, cameras and microphones, to eBooks and digital text books, to interactive learning networks and instant feedback” (p. 1). The concept of using this advanced technology, anywhere, anytime is seen to be ground breaking; it was seen to be a revolutionising tool. The user would only need one thing, the Tablet PC. The researcher will now consider students and teachers separately.

Students using Tablet PCs

Previous research by Twining et al. (2005) showed that students used the Tablet PC in a variety of ways. The majority used the pen and its technology to take notes in class. The mobility of the Tablet PC allowed students to take it anywhere, into the classroom, the gym for a PE lesson or out onto the oval during recess or lunch. Students used software specifically designed for the Tablet PC, Microsoft OneNote, DyKnow or Windows Journal to organise their subjects, write notes or do worksheets specifically designed for the Tablet PC by their teacher. With Microsoft OneNote’s capabilities, students were able to record lectures or lessons while they wrote their

own notes. Some even used the Tablet PC to record video through a web cam and have that also embedded in the OneNote file. These files could then be saved and reviewed at a later date (Cicchino & Mirliss, 2004). This allowed students to reduce the number of books that they needed to carry around with them. Microsoft OneNote was also used by Microsoft Corporation (2011b) as a way to standardise delivery; teachers' OneNote workbooks included text, video, audio and graphical material, then students wrote comments into those files using the Tablet PC's pen technology. Students were able to annotate work and send it to either their teacher to review or to colleagues for collaboration. The Tablet PC gave the students the ability to be able to draw diagrams and pictures and easily insert these straight into their work.

Software such as the Microsoft Office suite with inking capabilities was used and many students used Microsoft Word to write notes or annotate typed work. Microsoft PowerPoint is another piece of software that was commonly used to create assessment tasks (Twining et al., 2005).

The technology allows students to pick and choose how and for what they use the Tablet PC - it is a lot easier than that of the traditional pen and paper. Twining et al. (2005), suggested that students can be accommodated for their different learning styles quickly and easily. As stated by Galligan, Loch, McDonald, and Taylor (2010), "The handwriting was 'most helpful' in problems that involved diagrams and angles" (p. 45). The Tablet PC acted like a pen and paper; students could quickly sketch out their ideas, such as sketching complex shapes or writing Math equations easily.

Many of the case studies indicated that it was a fantastic way for students to store their books and notes; everything in the one place, no issues with students forgetting to bring a pen or something to write on. Ifenthaler and Schweinbenz (2013) and Kosheleva et al. (2006) both found that the Tablet PC was like a portable classroom where students always had their books, assignments, notes and study resources. There was no reason for students to not have the required tools for learning.

A report from British Educational Communications and Technology Agency (BECTA) (2004) stated that students commented on how learning was now fun and more enjoyable, they were becoming motivated to learn. They had improved their attention spans in the classroom; interaction with others had also increased. Many students' motor control skills improved via the use of the pen and the Tablet PC. The report also stated that students found the Tablet PCs easy to use and were motivated to work using them. Teachers cited this motivation as a significant factor in student academic progress, most frequently with regard to handwriting skills. It was also stated that Tablet PCs were associated with improved behaviour and self-esteem of pupils and promoted collaborative learning. Students claimed it was the ability to fold flat and the mobility of the Tablet PC that encouraged its use and increased the amount of time they spent working. Both Reboli (2007) and Enriquez (2010) agreed that the use of the Tablet PC increased motivation, and hence was likely to have a positive impact on learning outcomes. Its use also supported moves to more independent and collaborative study as well as giving students confidence in learning, improving their interaction with other students, and increasing their knowledge retention. Students reported that having the Tablet PCs and supporting software made school more enjoyable.

Teachers using Tablet PCs

Teachers used the Tablet PC in much the same way as the students did. It was mainly to annotate students' work or to create student tasks and worksheets. Teachers used the inking technology with the aid of a data projector to display class notes on the board and record lessons via software like Microsoft OneNote. Teachers marked work using the pen and inking capabilities to annotate student work that had been submitted via the network, USB or email, as suggested by Microsoft Corporation (2011a) and Sheehy et al. (2005). This reduced the need for work to be printed out, which saved on paper, and reduced the likelihood that the teacher would lose the students' work.

Teachers used programs similar to Microsoft OneNote to write, draw and record lessons or to prepare lessons ready to teach. These lessons could then be put on a

network to be shared. Reports from BECTA (2004), Microsoft Corporation (2011a) and Mock (2004) found that teachers were using programs to record and capture lessons and record audio comments as they were annotating student work. Mock (2004) also suggested that teachers used the Tablet PC as a brainstorming tool instead of students coming up to the board or the teacher writing on the board; the teacher could pass the Tablet PC around the class and the students could write on the Tablet PC, sharing everyone's ideas via the data projector.

The Tablet PC was also used instead of the whiteboard as a note-taking tool; teachers connected the Tablet PC to a data projector and wrote notes on the Tablet PC using software like Windows Journal or Microsoft OneNote. This had many benefits, as the teacher was able to look at the students when writing the notes instead of having their back to the classroom. Anderson et al. (2005) state that, "It gave the ability to facilitate interaction between students and instructor" (p. 4). They were also able to save the notes displayed on the board for students to obtain later as suggested by Cicchino and Mirliss (2004).

Teachers used different types of software to communicate with the students in the classroom. This software allowed the teacher to see the students' monitors and make inking comments on students' work while teaching in the classroom. They could even display a student's monitor on a big screen for all to see via a data projector. This allowed for two-way communication between each student and the teacher during class, allowing the teacher to comment on a student's work as soon as the student had finished. Mock (2010) suggests that this approach actively encouraged students to participate in exercises and allowed them to receive immediate feedback, instead of waiting days for the work to be corrected and returned.

Staff noted that administrative tasks like marking rolls and students' work was made a lot easier by this technology as recorded by BECTA (2004). Staff had students' work submitted electronically and, via the pen and hand recognition software, marked students' work without having to print it off. This saved time and effort for the

teacher, it also reduced the chances of teachers losing students' work as it had been saved on the school's network. It was also stated that students found it a lot easier to submit work electronically, either by the network or email.

The report from BECTA (2004) also suggested that the flexibility of digital ink, in allowing teachers and students to add handwritten notes, pictures and diagrams to work was also seen as being very valuable. There was almost universal agreement on the motivational aspects of Tablet PC use for pupils, with improvements in concentration, self-esteem and communication skills, and the development of researching and recording skills.

Tablet PCs were recognised as having an impact on teaching practice by opening up new ways of working. The use of Tablet PCs was considered to have enhanced the pace of lessons but also to have led to the need for more classroom support. As learning support assistants often provided such support, Tablet PCs were seen as increasing the range of skills demanded of these staff. There was a strong feeling in the schools that Tablet PCs had the potential to enhance learning and that this went beyond what was possible with other technologies. Twining et al. (2005) stated that:

It was clear that Tablet PCs had a very positive impact in this regard (only diminished when there were technical problems). Students appeared to relate to Tablet PCs differently from the way in which they related to other computers. This may have been due to the more "natural" way in which they could physically interact with the Tablet PCs, in terms of variety of position (on their knee or held in one arm, for instance) and also the immediacy and intuitive nature of using a pen on the screen. There is significant potential for the development of software that makes use of these features of Tablet PCs. (p. 22)

Tablet PCs opened up new ways of working. In particular they could encourage different teaching styles and support different learning styles. Teachers suggested that the Tablet PC opened up new and exciting approaches to teaching; there was another dimension in the way in which you could teach. Students could now see, hear and touch their work as it progressed, becoming completely absorbed and fascinated in the results of their own actions (Twining et al., 2005). Teachers were

changing the way they looked at teaching each topic; the Tablet PC has the scope to do alternative tasks in the classroom. Teachers were able to concentrate on teaching the concepts, not just copying large slabs of text out of a book and onto a whiteboard, as suggested by a member of staff at Torrey Pines High School (Microsoft Corporation, 2007).

In subjects like Mathematics, teachers have been able to use the Tablet PC to a far greater extent (Microsoft Corporation, 2007). The use of the pen has given the teachers more freedom to write equations and draw graphs with ease; these equations could be easily saved for later use, not wiped off as they would be if written on the whiteboard. The pen has reduced the amount of time they spend creating worksheets and tests, as they can now simply write the equation or draw the diagram, instead of having to fiddle around trying to use the equation editor in Microsoft Word or the drawing tools. The Tablet PC provides tactile interaction with the students' work and ideas as seen in research by Galligan et al. (2010).

The report from Ferrer, Belvis and Pamies (2011) suggested that the weakest students were those who had improved the greatest as a result of using the technology. The Tablet PC was the tool that gave the greatest attention to the weaker students with difficulties in handwriting. It was noted that the pen technology of the Tablet PC assisted many students in handwriting skills development.

Portability of the technology allows for mobility around the classroom and the ability for more of the classroom to be taken out onto sporting fields, field trips, excursions or camps. With the use of wireless data projectors, staff can now walk around a classroom with the Tablet PC in their hand, still connected to the projector. BECTA (2004) and Mock (2004) found that with the Tablet PC connected wirelessly to a data projector, the teacher did not always need to be at the front of the classroom. It added another dimension to the lesson; students could easily be contributing to the class discussion without having to leave their seats. The Tablet PC could simply be handed to them and they could write or draw so all in the classroom could see. The

feel and ease of use was noted as more natural. Students and teachers felt that the Tablet PC was much more intuitive to use. Students found the navigation of the Tablet PC with the pen a better feel than the mouse or touch pad.

Advantages of the Tablet PC over a traditional Notebook

Because the Tablet PC screen can be folded flat, it is less intrusive in the classroom; teachers can easily see the students' faces and what they are doing. The report by BECTA (2004) suggested that by having the Tablet PC screen in the flat slate position, teachers had a far greater view of the classroom; there was no intrusive barrier between the teacher and the student. Many teachers stated that there were issues with student/teacher interaction in the Notebook classroom as they could only see the backs of the students' laptops. Teachers were not confident in knowing exactly what the student was up to. Others have raised concerns that the traditional Notebook prevented eye contact with the students; teachers were finding it distracting to have students watching their screens or the screens in the row in front of them e.g. Microsoft Corporation (2005). Many teachers noticed the use of the pen is also a lot quieter than the "click clack" of the keyboard working away and that when their students started using the pen instead of the keyboard, the noise level dropped and the dynamics of the classroom changed (Microsoft Corporation, 2005).

The Tablet PC is even more mobile than the Notebook. Because it can be folded flat, it is easily passed around in the classroom. It has greater flexibility in how and where it is used; it is easy to hold in your arms or on your lap. It can be used in the field, in a Physical Education lesson on the oval or at the swimming pool. The report by BECTA (2004) states that, being able to hold the Tablet PC in one hand, and input data with the other, was seen as a significant benefit. Teachers could easily record valuable data about the students' learning without having to either go back to the teacher desk or the classroom if outside.

A number of advantages have been identified when the Tablet PC is in the slate position. Twining et al. (2005) found that when in the slate position, the Tablet PC takes up less space in the classroom; there is still space on a classroom desk for

student workbooks. This was especially apparent in the primary classrooms where students usually sit around tables joined together. The report by BECTA (2004) suggested that when used with a data projector and in slate mode, teachers/lecturers could write directly onto the Tablet PC and have their notes displayed on the big screen. This allowed the teacher to be facing the students when they were writing on the board. The notes could also be saved and uploaded to the network so, if students missed anything, they were able to get them at a later date. Since the teacher's lecture notes were all electronically saved, it was easy for the teacher to quickly go back over the day's notes and modify or add before the notes were distributed to the students. The report by Microsoft Corporation (2005) indicated that the use of Microsoft OneNote became the replacement of the chalkboard "one in which in-class notes and diagrams are saved and posted to public folders, rather than erased" (p. 5).

A further advantage of the Tablet PC that has been identified in some research is the use of the "inking" capabilities to mark students' work (e.g. Cicchino and Mirliss 2004). Students submit their work electronically and the teacher is able to mark the work on the computer using the "inking" capabilities. They can also annotate students' drafts and then send the work back to the student. The students can then easily make the changes and remove the inked comments.

With the use of software programs like Microsoft OneNote, teachers could involve the students in online discussion. By linking all the computers up to the teacher's, the students are able to see the teacher's screen on their own screen. They are then able to add to the discussion by writing on the screen using the pen. All students can see what each other is writing. Cicchino and Mirliss (2004) suggested that the Tablet PC gives teachers the ability to create interactive presentations that include student comments and observations, which can be saved and distributed to the class. It allows them to brainstorm, collaborate, and storyboard with students, eliciting their input and sharing this information. The report by Microsoft Corporation (2011a) stated that, "Teachers have discovered that OneNote helps them collaborate too,

which helps Prince Alfred College create the stimulating learning environment it strives for” (p. 4).

The research by Twining et al. (2005) and Kosheleva, Rusch and Loudina (2007) suggested that the Tablet PC is particularly useful in subjects like Maths and Science where the use of a pen has considerable advantages over a mouse. Diagrams can be annotated more easily. Templates can be filled-in which saves the students’ time in copying diagrams. Using the pen to draw, for secondary students, is a lot easier than the mouse or track pad and can even do a number of skills that the mouse cannot. Pen-based inputs make drawing and linking components even easier than using a mouse. Further, the report by Microsoft Corporation (2012) stated that the stylus technology allowed the students to use the Tablet PC as a digital book; they could use the pen, write class notes, draw diagrams and work through equations.

Handwriting technology can be used to help students with problems or disabilities in using a conventional Notebook. Students now have the opportunity to gain access to information and technologies they may not have had access to previously (Sheehy et al., 2005).

Limitations of a Tablet PC

While the ability to convert handwritten text to typed text has been a huge drawcard with the Tablet PC technologies, teachers in many schools stated that, while it was a technology used, it was not high on their list of “must use” technologies as it was cumbersome and difficult to use. This was evident in BECTA (2004) and Twining et al. (2005). Many students’ handwriting was not converted with any accuracy. Both had concerns over how easy it was to use, especially with the younger students.

The majority of the limitations of the Tablet PC were related mainly to where and how the Tablet was used. Teachers in many schools stated that the lighting was a factor when using the Tablet PC in the slate mode. The light would reflect off the screen and make it hard to see exactly what was on the screen. The report by BECTA (2004) found that the biggest difficulty encountered was that of the screen lighting.

Viewing the screen was difficult in many conditions and this meant that students could not easily use the Tablet PC when and where they wanted to. Glare from lights or windows made it difficult to see. Many schools reported a steep learning curve on how to appropriately use the equipment; for example, many reported that their pens were either being broken or lost (Sheehy et al., 2005).

When using a data projector, the Tablet PC must be placed in landscape mode instead of the more comfortable portrait mode. Teachers in some schools stated that they had issues when trying to switch between portrait and landscape screen. Real estate for drawing and writing is smaller than what is normally available in a classroom with a large blackboard. The report by BECTA (2004) noted this as a slight issue early in the use of the Tablet PC with a data projector but as the teachers got used to working with the smaller real estate, it was not really an issue anymore.

The battery life of any Notebook has always been a point of contention. With the introduction of the Tablet PC came a Notebook that required a battery with more capacity as a result of the screen needing to be a lot brighter than a normal Notebook. It was obvious, early on, that a typical Notebook battery would not be sufficient for the Tablet PC. Many teachers and students in most schools considered the battery life too short. This was evident in reports by BECTA (2004) and Twining et al. (2005), who both agreed that the battery life was far too short for what they wanted to do with the Tablet PC.

Galligan et al. (2010) suggested that there were a number of limitations for teachers and students in using the Tablet PC. For example, clear handwriting was still required; complex Maths solutions could get messy; the technology would not always work; many students took time to adjust to the new technology; and when collaborating, issues of confidentiality had to be considered.

Tablet PC unique features and software

There was a wide range of software mentioned in the literature reviewed. Many software applications were common to the Tablet PC and were used by teachers and

students in numerous institutions; however, only a few were using software particular to the Tablet PCs. There was a number of software applications designed for a specific purpose and only used by select schools that had a direct purpose for that software. Software that was common to the majority of institutions included Windows Journal; Microsoft Office Suite including OneNote, Word, PowerPoint, Excel, and FrontPage; My Font tool; Sticky Notes; Snipping tool; Microsoft Education Pack – Equation Writer; Goblinder; Ink Flash Cards; Microsoft Experience Pack; Ink Board; Wordshark and Flash.

There were also a number of other software applications that, while not specifically native to the Tablet PC, were recommended to be extremely useful in the implementing and maintaining of the Tablet PC programs. These were M2Screen, Visio, ArtRage, EchoView, DyKnow, Tegrity Instructor software, Microsoft Office, SharePoint Portal Server 2003, VNC software, and Discourse software. It needs to be noted that with the introduction of Microsoft Vista, a number of the Microsoft XP Tablet PC add-ons has been integrated into the Vista operating system.

The Tablet PC had introduced new types of software applications as well as extended standard software packages in a whole new way. With the ability to use a pen, the Tablet PC screen had opened up new ways to engage the students. Students suggested that they had become more focused in the classroom. School was beginning to be fun again, as seen in the report from BECTA (2004).

Both students and teachers made use of software such as Microsoft OneNote or Microsoft Journal that had the unique ability to use a pen to write ('ink') using the unique software. Microsoft Corporation (2011b) showed that this software also allowed the teachers and students to compile workbooks that included text, audio, video and graphics that reduced the need to carry traditional books with them.

Improved ICT skills

Mock (2004) suggested that the Tablet PC had unlocked the user's capability to use a number of different software types, which in turn had given the user the ability to

learn new skills or improve those ICT skills already learnt. He proposed that the introduction of Tablet PC software like Microsoft OneNote, PowerPoint, or Journal introduced the user to new skills that could only be learnt using a Tablet PC. Ferrer, Belvic and Pamies (2011) suggested that the pen technology assisted many students in improving their handwriting skills via the pen technology, which then supported the students in improving their ICT skills in other areas. It was also suggested by schools that the Tablet PC had the potential to enhance learning far more than any traditional style of learning, as seen in Twining et al. (2005). These schools could see the potential for the Tablet PC in improving everyone's ICT skills.

Pedagogies/New teaching styles

Twining et al. (2005) suggested that there was a wide range of new strategies being used in the classroom by both students and teachers, many having a significant impact on the learning of the students. The Tablet PC supported and extended the curriculum and broadened the practice of the teachers. They saw how the technology had already transformed aspects of their teaching and could do so in the future, "The result of using Tablet PCs alongside these approaches was that staff had begun to expand their use of ICT into preparation and teaching in both classrooms and sports areas" (p. 51). Students relied more on what was stored on their Tablet PC and less on the books and stationery that they had previously been required to supply in each class. Information could be gathered far quicker and then processed into output a lot easier than traditionally.

These reports found that teachers had changed the way they were teaching, from the more traditional style of being teacher-focused, to a very interactive student-centred approach. The Tablet PC had allowed students to become much more involved in the overall structure of each lesson. Information was being obtained at a far greater pace; teachers were becoming better prepared for lessons and could show a more diverse range of resources far more easily. There was far more interaction between the teacher and the students as well as between the students themselves. The Tablet PC encouraged more discussion in the classroom. Coe and Preist (2004) suggested in their research that teachers now saw ICT as just another

teaching tool, not a completely separate subject. Teachers changed the way they planned and taught classes, using the Tablet PC, and programs like Microsoft OneNote, to do away with textbooks and workbooks, to replace them with an electronic version that used the “inking” capabilities of the Tablet PC, as seen in research by Mock (2004). Cicchino and Mirliss, (2004) in their research, found that this allowed the teacher to be able to mark the students’ work with ease, reducing the time taken to mark and return the work, increasing the speed at which feedback was given.

Classroom setup and implementation

Reports from BECTA (2004), Microsoft Corporation (2011a) and Twining et al. (2005) all recommended that any future implementation of a Tablet PC program into a school or college should consist of a 1:1 convertible Tablet PC program, either school or student owned. It was stated that if the school owned/rented the Tablet PCs they would have more control over what was installed on them, reducing the chances of something going wrong with them. Appropriate infrastructure was vital to a successful program, including data projectors in every room, with a wireless network covering all parts of the campus. Ongoing staff and student training were also vital as both need access to ongoing support mechanisms, either electronically or via ICT support centres. Microsoft Corporation (2005) felt that “a standardized solution is making a difference because professors can easily share student work with each other” (p. 4).

These reports found that classroom setup and implementation changed. Teachers suggested that the ability of the screen to fold flat changed the dynamics of the classroom; students became more involved in the class, as suggested by Cicchino and Mirliss, (2004) and Microsoft Corporation (2005). It was seen as less distracting and intrusive - the teachers could see the students’ faces, as they were not hidden behind a computer screen. The ability to fold the screen flat also increased the mobility of the machine; the Tablet PC could easily be handed around the classroom or used in locations that a traditional Notebook found difficult. Microsoft Corporation (2011a) suggested that lessons had far more flexibility in how they could be conducted. This

gave more opportunity for different learning styles to be displayed, catering for the different ways students learn.

Mobility

The Tablet PC allowed for mobility around the classroom, both the teacher and the students could now move freely around the classroom with ease and without any deterrents like power cords or network cables. The Tablet PC in slate mode made the handling of the Tablet PC a lot more comfortable, as supported by Mock (2004) and BECTA (2004). The Tablet PC also allowed for technology to be moved outside the traditional bricks and mortar, to the sporting fields, excursions or camps. It was also stated by Twining et al. (2005) that the Tablet PC, when in the slate position, took up less space and was extremely easy to hand around the classroom, especially in the primary classrooms, where students usually sat at tables facing each other.

Previous research showed that the Tablet PC could have an enormous impact on the way teachers prepared, constructed and taught lessons, as well as the way in which students learned. Mock (2010) stated:

A Tablet PC with an active digitizer for writing digital ink is probably the single piece of technology that has had the largest impact on my teaching. If you use PowerPoint, then you can easily transition to using a pen to annotate your slides, Microsoft OneNote, Microsoft Windows Journal, and Jarnal (free), mimic writing on paper. (para. 6)

Conceptual Framework

The conceptual framework (see Figure 2.1) was created from the literature review and this has been used to guide the data collection as well as assist in better understanding the issues around learning engagement with Tablet PCs. Gay, Mills and Airasian (2006) suggests that conceptual maps give the participants an opportunity to display their analyses of the problem and help the researchers to determine consistencies and inconsistencies that may exist between the disparate groups. This map was further broken down into its current form, which this research study is based around.

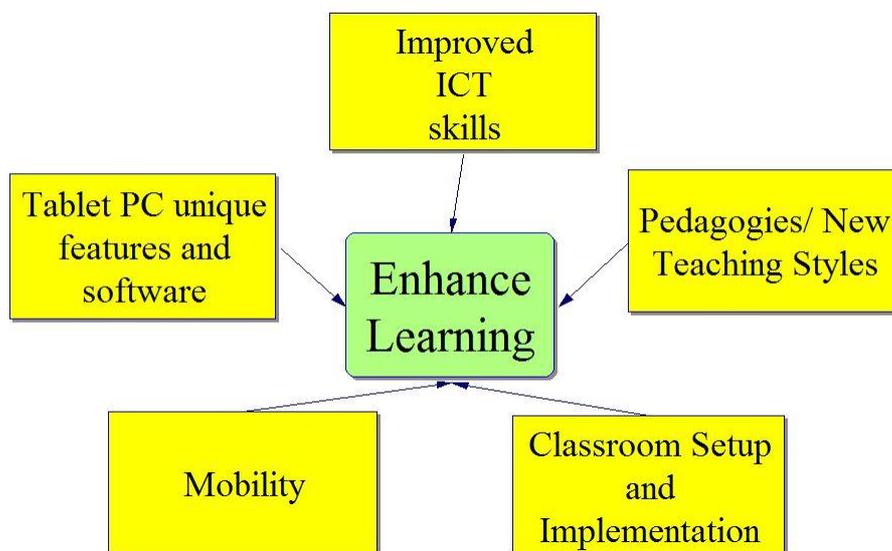


Figure 2.1. Conceptual framework used in the study

The research set out to look at what constitutes the key attributes of enhanced learning. In order to do this, six attributes were included: Tablet PC unique features and software; Improved ICT skills; Pedagogy; Classroom setup and implementation; new teaching styles and Mobility. These were seen as the most important factors in answering the research question. In the next chapter the methodology shows how these attributes were measured.

Summary

As is evident from the literature reviewed, there has been very little research completed that is exactly like the study that has been conducted here. This study is significant in that touch and pen sensitive devices similar to the Tablet PC are now becoming an integral part of teaching and learning in an increasing number of schools in Australia (Eady & Lockyer, 2013). The school the researcher was working in at the time of the study was an earlier adopter of the Tablet PC technology, therefore this study focused on the Tablet PC. However, during the period of the study, the touch screen and the interaction have become more mainstream.

This chapter identified and reviewed research and current practices relating to Tablet PCs in education and summarised how the present literature relates to the study. The next chapter details the method of inquiry undertaken in this study, as shaped by the research question, and describes the research methodology and design.

CHAPTER 3

RESEARCH METHODOLOGY

Overview

This chapter describes the way in which the research was conducted. It describes the overall picture of the type of instruments used in the study. It discusses the methodologies used in the research, including the design, the sample selection, the research setting, data collection and analysis, as well as the limitations of the study.

Introduction

This section describes the conceptual framework that the research study was based around. This study was based around a mixed research method of quantitative and qualitative methods of research. Quantitative research collects facts and studies the relationship of one set of facts to another (Bell, 2005). Qualitative research is more concerned with an individual's perception of the problem. Qualitative research includes approaches using one or more of the following; grounded theory, ethnographic research, case study and action research. Gay et al. (2006) state that:

Qualitative research differs from quantitative research in two key ways: (1) Qualitative research often involves the simultaneous collection of a wealth of narrative and visual data over an extended period of time, and (2) as much as is possible, data collection occurs in a naturalistic setting. In other words, qualitative researchers try to study phenomena where they naturally occur. (p.399)

Data collection within qualitative research methods can include direct observation and interviews. Data collection within quantitative research mainly concerns itself with questionnaires and surveys (Bell, 2005). Whichever methods are chosen, every effort should be made to cross-check findings by triangulating data collection using a number of different data collection methods.

Re-statement of the research question

This thesis explored how the Tablet PC can be used to enhance the learning environment within a classroom for students. Thus, this study looks at a crucial question involved with the use of the Tablet PC in a classroom.

The question addressed is:

What effect on teaching and learning activities does using Tablet PCs have in Year 5 to 9 classrooms?

- Setup of the classroom
- Implementation of lessons
- Features of Tablet PC being used by teachers
- Pedagogies being used with Tablet PCs
- Interaction between

- Students and teachers
- Students and students

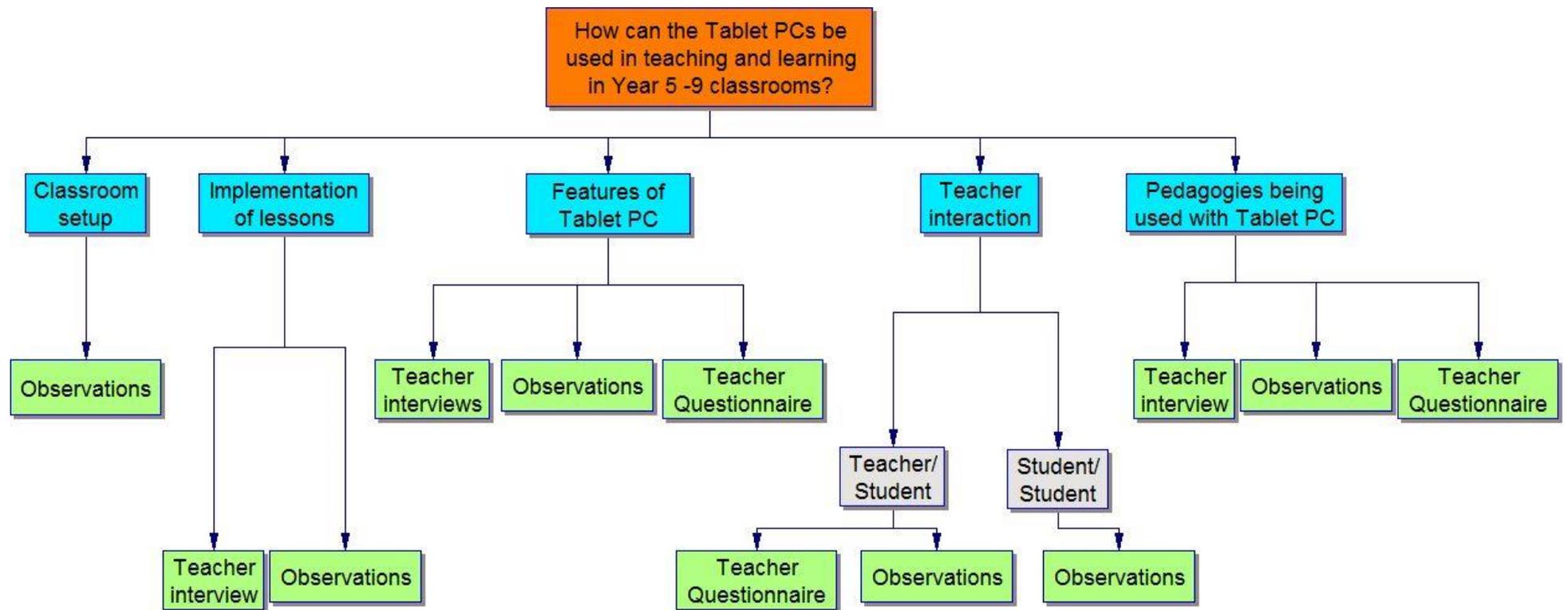


Figure 3.1. Research question, data sources and methods of analysis

Research design

In this study qualitative methods were used to collect data from teacher questionnaire surveys, teacher interviews, classroom observations and classroom video. Some aspects of this data collection were also analysed using quantitative methods. Figure 3.1 shows how the research question, data sources and method of analysis all fit together. Figure 3.2 shows the overall research design used in the study.

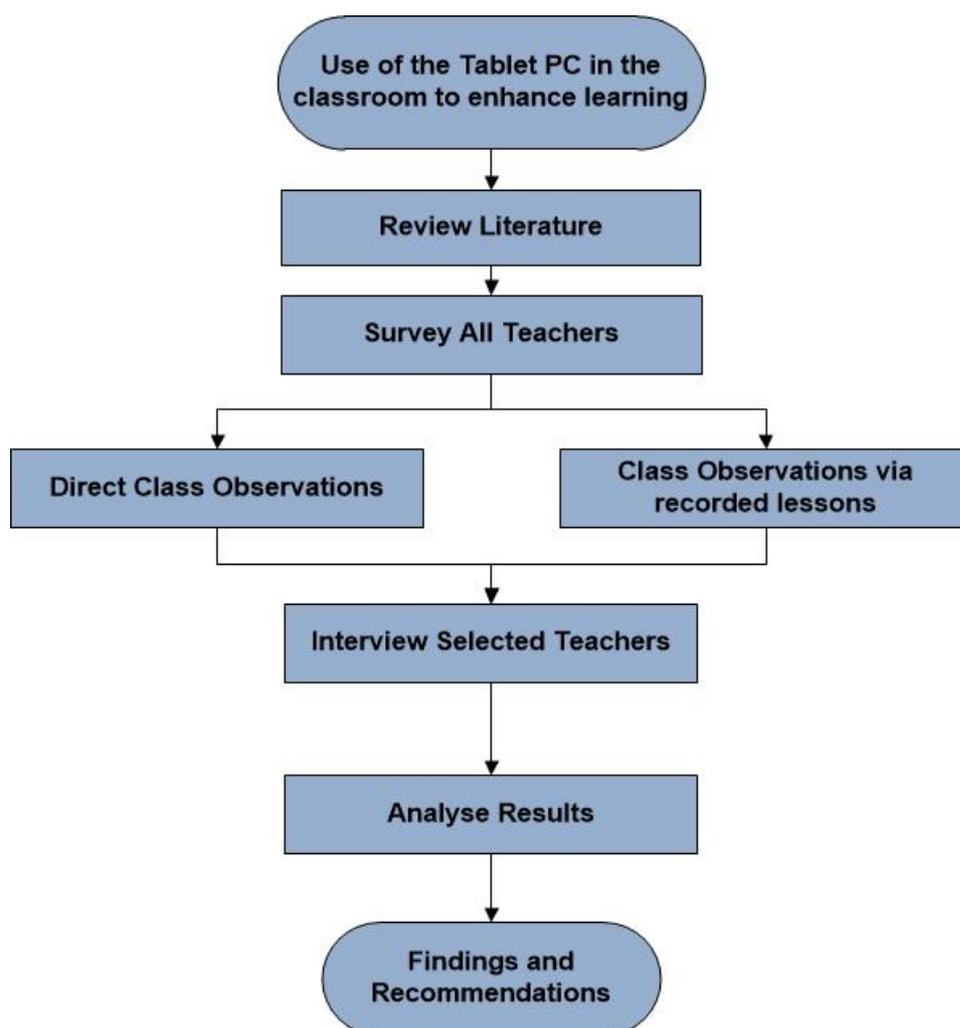


Figure 3.2. Research design framework

Sample selection and role of researcher

The sample selection was not a random selection but one of convenience, and thus care needs to be taken in analysing the results. The researcher was the Head of ICT in the school. All staff members were invited to partake in a questionnaire (see Appendix B). From the teachers that responded to the questionnaire, ten were

chosen to be interviewed using the “Experience of Change” (EoC) method of interviewing (Ainscow, Hargreaves, Hopkins, Balshaw, & Black-Hawkins, 1994, pp. 17-24)(see Appendix A). The ten teachers were chosen as they had a wide range of experience and skill in using a Tablet PC in the classroom. Of the ten selected, only six indicated their willingness to participate fully. The selected six also had a number of their classes videoed and directly observed. While the data was not validated with the respondents, it is believed to be a true representation of the events that occurred. The students participating in the study were all of those in the selected teacher’s classes.

The researcher was aware that his role within the school (Head of ICT) could have influenced the responses from the teachers in both the questionnaires and the EoC interviews. To minimise this, the questionnaires were anonymous. In the EoC interviews, it was made clear to the teachers that they were allowed to speak openly without concerns about consequences of their responses. The researcher was not the line manager of any of the teachers interviewed in the EoC interviews nor was any of the information from the interviews given to the teachers’ line managers, the teachers were aware of this. The researcher was not a teacher of any of the students participating in the research.

Research setting

The research setting was an open-entry independent school with around 1200 students from Kindergarten to Year 12, including 150 boarders. There were 120 full time equivalent staff members across three campuses - Junior Campus: Early Learning to Grade 4, Senior Campus: Grade 5 to Year 12, and a Year 9 retreat campus.

The school was a compulsory Tablet PC school from Years 5 to 9. At the time of the research, not all students in the Notebook program had a Tablet PC, due to the implementation of the Tablet PC program not having had enough years to filter throughout all year levels.

All classrooms at the school had been fitted out with the appropriate technology to run a functional classroom. The school was equipped with full wireless coverage with over 60 access points running either 802.X G or N. Only a few classrooms had at least one network node and 10 power points. Most classrooms had between 20 and 30 network nodes (with power points alongside) around the outside of the classroom, with any building constructed from 2005 onwards having at least five floor boxes in each classroom. Each floor box had provision for four network points and four power points. There was a data projector in every classroom in the school. Classrooms, in which the data was collected, fell into the category of rooms that had floor boxes as well as wireless access. All classrooms had access to the internet via a firewall, which allowed for comprehensive web and email filtering, maintaining a high standard of safety via the internet.

The school also had a number of servers that were allocated to numerous roles, one being the Learning Management System (which gives the teachers and students the ability to access and share information and files). Attached to the Learning Management System were the school's Inboxes and Outboxes. Other staff members and students then gained access to the files, via either opening, copying or dragging the file(s) to another location.

The school employed six full time staff to run and maintain the school Information and Communication Technology area as well as the Tablet PC program. The Head of Information Communication Technologies (ICT) oversaw the running of the Tablet PC program and ICT at the college; the Information Technology Manager managed the infrastructure; the Systems Engineer maintained the network; two Tablet PC technicians maintained the school Tablet PC program and the school's desktop computing fleet; and a Programmer created and maintained applications for the Learning Management System. While the school environment was well advanced in the use of information and communication technologies, the academic staff were not very well catered for with regards to support and training around the use of the Tablet PC and its relevant software.

Data collection

This study collected data on how the teachers and students were using the technology, as well as what enhanced learning and teaching styles were being used. This was done via the use of teacher questionnaire surveys, teacher interviews, classroom observations and classroom video recordings.

Questionnaires

Questionnaire surveys are a very important tool in the collection of both qualitative and quantitative data. Gay et al. (2006) suggested that a questionnaire survey has definite advantages over other methods of data collection; they require less time, are less expensive and permit collection from a much larger sample. All teaching staff at school were invited to participate in a questionnaire survey (See Appendix B) that was adapted from an instrument developed by the Centre for Schooling and Learning Technologies at Edith Cowan University and an instrument developed at the Kaneb Centre for Teaching and Learning, University of Notre Dame.

The expected outcomes of this questionnaire were to obtain an understanding of what and how teachers at the school were currently using ICT in the classroom with their students and how the teachers were using the Tablet PC as a learning tool. This questionnaire was delivered in person to obtain the data.

Interviews

Semi-structured interviews using the “Experience of Change” (EoC) method of interviewing (Ainscow et al., 1994, p 17-24) was undertaken (See Appendix A) with six teachers. This instrument is frequently used to determine the feelings (both positive and negative) of participants in regard to certain topics; in this particular study – how they felt about the use of a Tablet PC. The purpose of this instrument was to gather data on how individuals within the organisation felt about change in their area. The EoC interview is one technique that allows staff members to talk openly about how they feel relating to a certain question. “This technique has the capacity to draw out deeply felt emotions about a particular change.” (Ainscow et al., 1994, p. 18).

This technique investigated the feelings of a number of teachers with regards to how they felt about a particular question, “How do you feel about your and the school’s use of the Tablet PC in the classroom?” Teachers were asked to place cards with feelings on them onto one of the four sorting card piles, “often”, “sometimes”, “hardly ever” and “doesn’t seem relevant”. Teachers were then interviewed focusing on the feelings in the “often” pile. Teachers were asked to give a detailed response to why they had chosen the “feeling” cards they had placed in the “often” pile. Gay et al. (2006) suggested the process of categorically marking or referencing units of text with codes and labels was a way to indicate patterns and meaning. This coded data formed the basis of what was further investigated as a result of the feelings of those teachers interviewed. Following on from the “Experience of Change” method of interviewing, a few key follow-up questions were asked to further entice teachers to respond to how the Tablet PC had influenced their teaching.

Classroom observations

In observations, the researcher obtains data by simply watching the participants. The emphasis during observation is to understand the participants in their natural environment, without altering or manipulating it, as recommended by Gay et al. (2006). All observations were recorded in specially set up observation rooms. Teachers and students were very familiar with this scenario as classes were regularly recorded for professional development of teachers. Within the school, the rooms that were used were, in most cases, the students’ homeroom.

Before the observations took place, a set of codes or categories were developed to assist in deciphering the observations. These codes were based on a system of interaction-process analysis, originally devised by R.F. Bales in 1950 (cited in Bell, 2005). The codes focused around the behaviours of both the student and the teacher, and the use of the Tablet PC. The codes that were used were: interaction with pen, use in tablet mode; use of inking capabilities; use of Tablet specific software; and interaction between teacher/student and student/student.

Field notes

As well as the coded documentation, field notes were also taken. Gay et al. (2006) described field notes as being as accurately as possible and as comprehensively as possible, all relevant aspects of the situation observed. They contain two basic types of information: (1) descriptive information that directly records what the observer has specifically seen or heard through the course of the study and (2) reflective information that captures the researcher's personal reactions to the observations, the researcher's experiences and the researcher's thoughts during an observation session.

Data analysis

Triangulation refers to cross-checking your findings; Bell (2005) suggests that in more extensive studies more than one method of data collection is needed. In this research study the findings are compared across a number of different data collection methods - questionnaires, interviews and observations, so that the data can be verified and validated. To assist in the data analysis, the multiple choice and Likert scale data were analysed using the statistical software SPSS (Statistical Program for the Social Sciences).

Ethical considerations

All interview proforma, questionnaires, recorded lessons and other items that required outside participation have been submitted to the Edith Cowan University Ethics Committee for approval. A disclosure statement (see Appendix B) was provided to teachers being observed, interviewed and questioned. Participants were advised that procedures were adopted to retain anonymity and a consent form was provided.

Summary

Chapter Three provided an overview of the methodology used in this study. The first section reiterated the research question, design, sample selection and the research setting. The next section described the data collection methods used (questionnaires, interviews, classroom observations and field notes). This was

followed by how the data were analysed. The final section outlined the ethical considerations for this study. Chapter Four describes, discusses and analyses findings of the study through the instruments used.

CHAPTER 4

RESULTS AND DISCUSSION

Overview

This chapter discusses in detail the results obtained via a teacher questionnaire to all staff at the school; teacher interviews of a few selected teachers; as well as direct observations of selected classes. Three teacher case studies were created to illustrate the types of teacher. They have been segregated into categories, creating three distinct groups: Early Adopter, Late Adopter and Reluctant Adopter. The chapter concludes with a summary of all results found. Once the teachers were interviewed and observed, a cross-case analysis was conducted to summarise and identify characteristics of the three groups.

Results from the teacher questionnaires

Across the staff, 120 questionnaires were handed out with 39 staff members responding. This response rate was disappointing. The researcher believes this low response rate was because only those who were enthusiastic about ICT bothered to respond. Questions were created that sought information around how the teachers and students were using the Tablet PC technology, what enhanced learning and teaching styles were being used and the different types of software used in the classroom by both teachers and students. The researcher believed that results from Question 7 (“To what extent does the work students complete using the Tablet PC contribute to assessment?”) and Question 8 (“Have your students used online resources over the last Term?”), did not provide enough valuable data to address the research question.

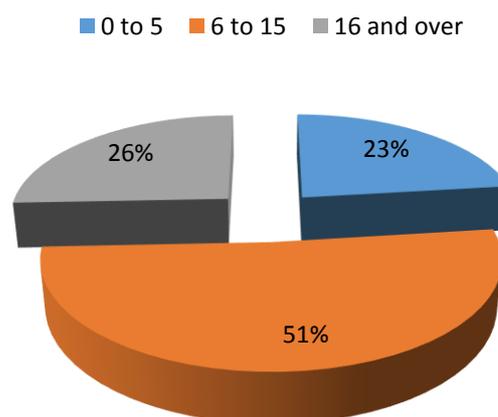


Figure 4.1. Years of teaching experience

As evident in Figure 4.1, 23% of respondents had been teaching for less than 6 years, 51% between 5 and 15 years, and 26% for 16 years or over. A teacher’s ICT capabilities have been identified as an important factor for effective use of ICT in the classroom (Hew & Brush, 2007; Pelgrum, 2001). Also the lack of teaching experience with ICT has been recognised as being significant in preventing teachers from successfully integrating ICT into their teaching (Mumtaz, 2000 cited in Vanderlinde and van Braak, 2010). Nearly a quarter of the respondents had teaching experience

of 5 years or less, which suggests that they may not have had the ICT competence to implement the use of the Tablet PC into their classrooms successfully.

Data in Figure 4.2 shows the teachers' perceived use of learning technologies with their students. As can be seen, most teachers (59%) believed that they were at a stage where they liked to direct student activities and choose the learning resources. 20% felt that they had begun to experiment with activities based on student choice, 15% stated that they liked to give students the opportunity to facilitate their own learning activities. Only 5% felt comfortable enough with the technology to allow students to take full ownership of their learning and construct meaningful problem solving activities.

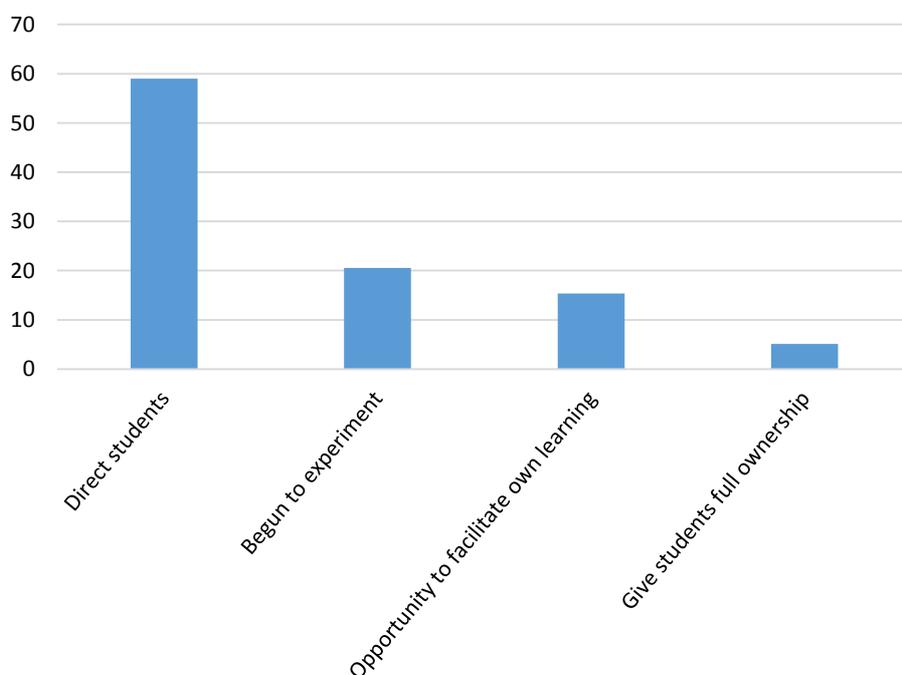


Figure 4.2. Teacher's descriptions of their perceived use of learning technologies (Question 11)

Figure 4.3 shows teachers' perceived views on how they use information technology to support student learning. The results from Figure 4.3 show that just under half the teachers (47%) believed that they were becoming confident in using the computers for particular tasks to support learning and 28% felt that they were not at all concerned about the technology and were able to use many applications to

support student learning. Whereas, only 25% stated that they were only aware of technology or were just starting to understand the process around using the technology to assist in student learning.

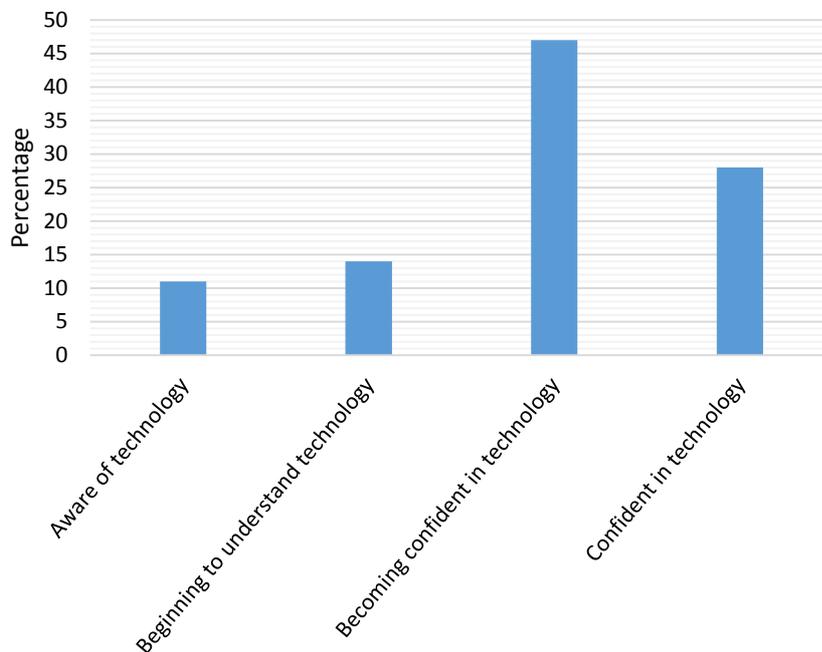


Figure 4.3. Teachers perceived views on how they use technology to support student learning (Question 12)

Data in Figure 4.4 shows staff self-perceived skill with a variety of software. The questionnaire asked teachers what they believed their skill level to be in relation to Tablet PC applications and equipment. As can be seen in Figure 4.4 at least 60% of the teachers indicated competency (or better) in most categories except Databases, Web Page authoring, and Video Photography. None of the three categories is mainstream software in the school's curriculum nor are they synonymous with the use of the Tablet PC.

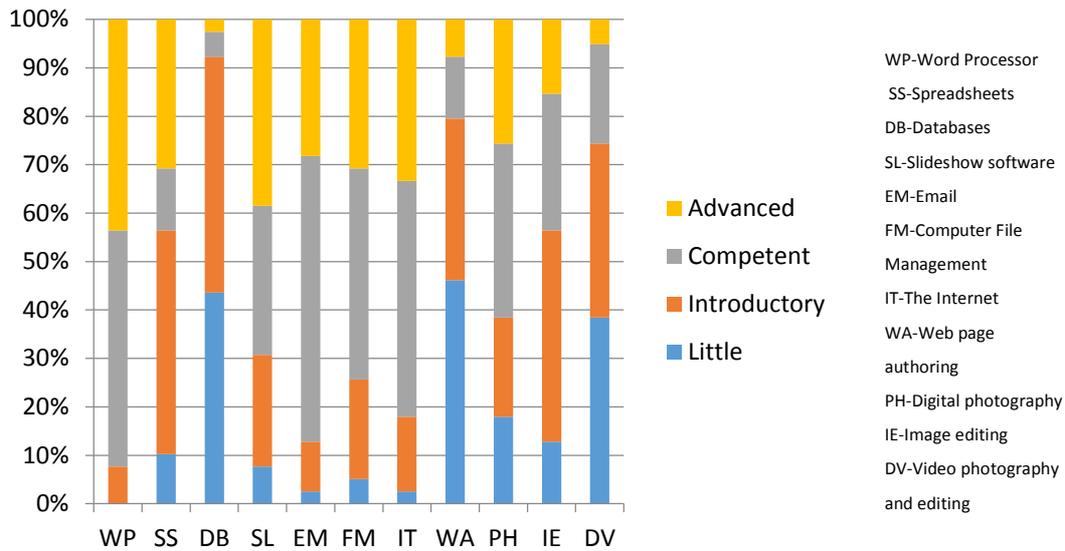


Figure 4.4. Staff perceived ICT skills (Question 15)

Figure 4.5 shows frequency of use of subject-related strategies with the Tablet PC as indicated by the teachers. Results from Figure 4.5 show that for most strategies, except Multimedia library and Student files, there were less than 25% of teachers that used the strategies every day or once a week. This indicates that the majority of teachers were not using the Tablet PC on a regular basis.

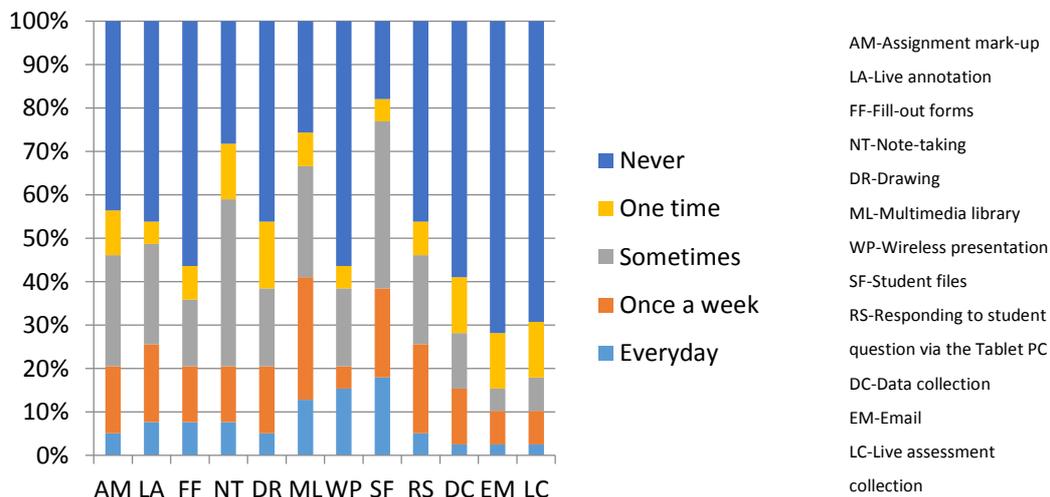


Figure 4.5. Frequency of use of subject-related strategies as indicated by teachers (Question 13)

In Figure 4.6, the results of the questionnaire in relation to how often the teachers utilised the various software types listed, are shown. The results demonstrate that there were a number of software types used on an everyday basis by a large percentage of the staff (>30%). These software types were the typical mainstream types – Microsoft PowerPoint, Microsoft Word, Microsoft Excel and Internet Explorer. Comparing these results with those in Figure 4.1 indicates that though staff had quite advanced skills, they did not apply them in the classroom.

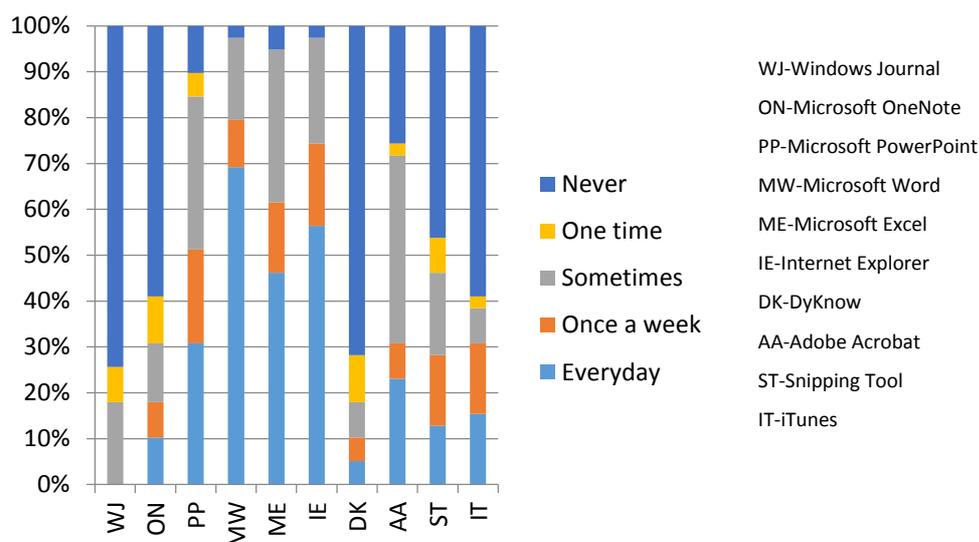


Figure 4.6. Software frequency use indicated by the teachers for various software types (Question 14)

The software types more suited to the Tablet PC like Windows Journal, Microsoft OneNote, DyKnow and Snipping Tool were used every day or once a week by less than 30% of the staff. In this instance, maybe the staff did not think the Snipping Tool was much use.

Features of the Tablet PC being used in classrooms

Results from the questionnaire showed that staff stated that they used the Tablet PC for a variety of activities. Figure 4.7 shows that there were only two learning activities for which a substantial number of teacher indicated what they used the Tablet PC for. These were 19% used the Tablet PC for research and 21% for Microsoft Office applications. It is interesting only 4% used the Tablet PC for annotating work, which

is an activity that would use a specific feature of a Tablet PC. There was a large range of other uses suggested such as reading instruction, storing of information and sharing past exams.

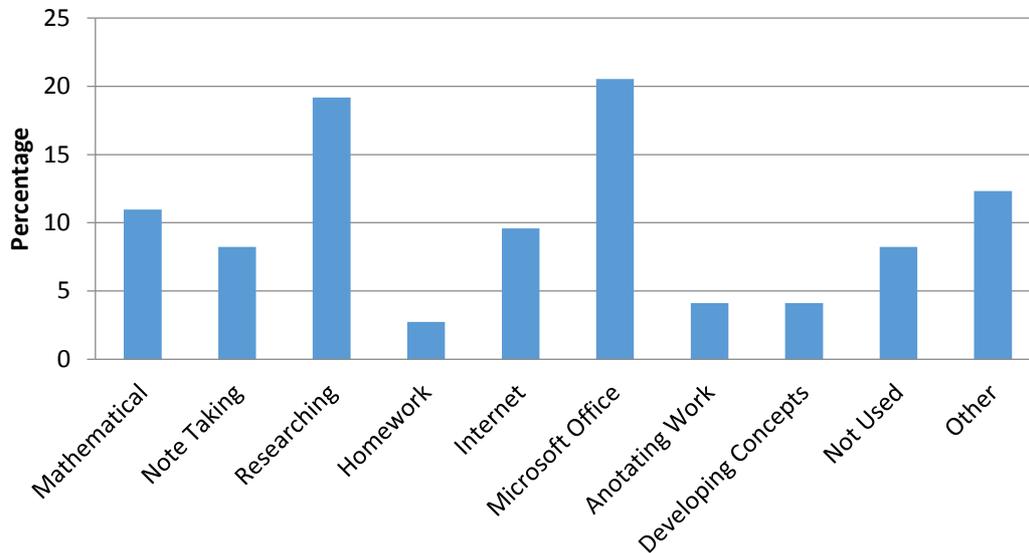


Figure 4.7. Learning activities that students used with the Tablet PC (Question 6a)

From the questionnaire, staff indicated (Figure 4.8) that they would like to use the Tablet PC for a number of new activities including: increasing their students' ICT skills (32%); exposure to greater understanding (19%); and better research (12%), with only 6% wanting to use the Tablet PC with their students for its inking capabilities, 14% stated they did not use the Tablet PC and 6% did not answer the question. There was a large range of other usages, such as – being creative, able to access information quickly and breadth of information. This indicates that the staff thought that the Tablet PC added value like a Notebook PC does.

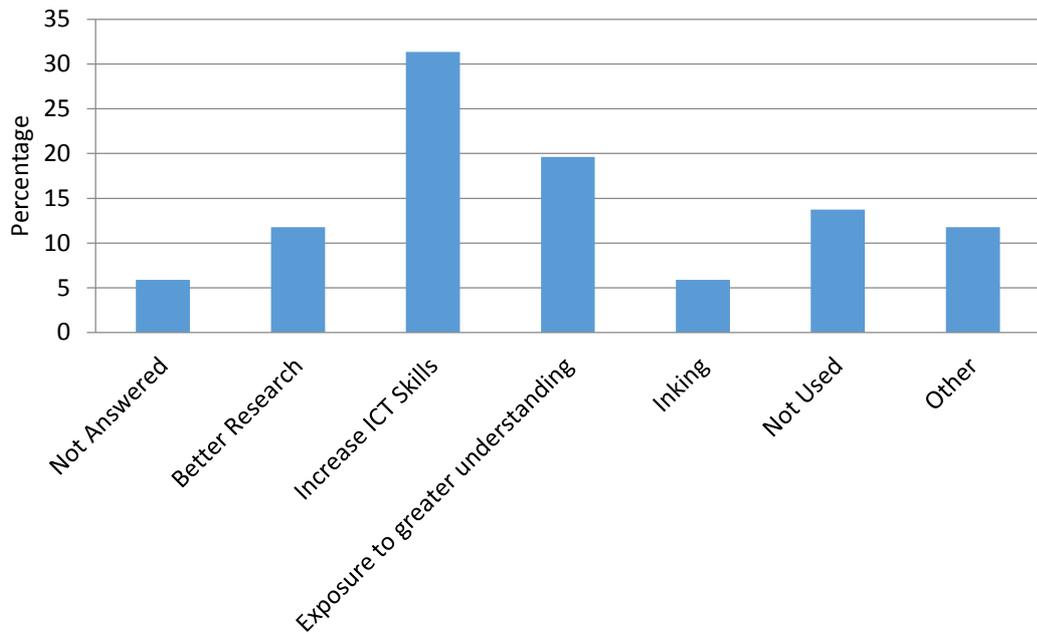


Figure 4.8. Expected added value from students using the Tablet PC (Question 6b)

Teachers were asked as part of wanting to increase their ICT skills and expose their students to greater understanding, what they would like to start using. As can be seen in Figure 4.9, it is noticeable that the largest proportion was N/A, that is 30% of teacher did not use the Tablet PC and only 20% or less identified software types DyKnow, Microsoft OneNote and inking. There were a large range of other uses suggested such as - assessment feedback, assessment tasks, using Interactive Whiteboards and creating graphs in Microsoft Excel.

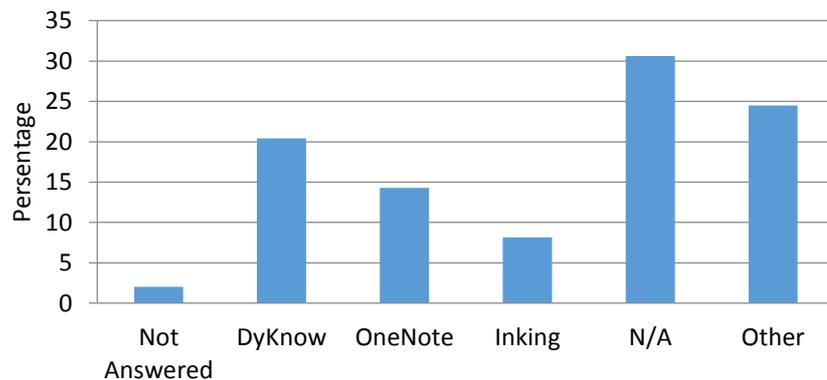


Figure 4.9. Future use of the Tablet PC (Question 6e)

While the results indicate that staff may not use the tablet feature as much as they would like, some staff indicated that there were at least two Tablet PC-specific software types that they would like to use more. These were Microsoft OneNote and Dyknow.

As is apparent in Figure 4.10, teachers felt that the most effective use of the Tablet PC in the classroom was for research (27%), presentations (18%) and for use of Microsoft applications (16%). There was also a large range of other suggestions such as – reading instructions, writing reports and illustrating points on diagrams. None of these responses had any direct connection with what teachers wanted to use the Tablet PC for, nor the actual Tablet PC features such as the “inking” capabilities and ability to use touch. This indicates that teachers really only used the Tablet PC as a Notebook and did not use the features of the Tablet PC anywhere near as much as they could.

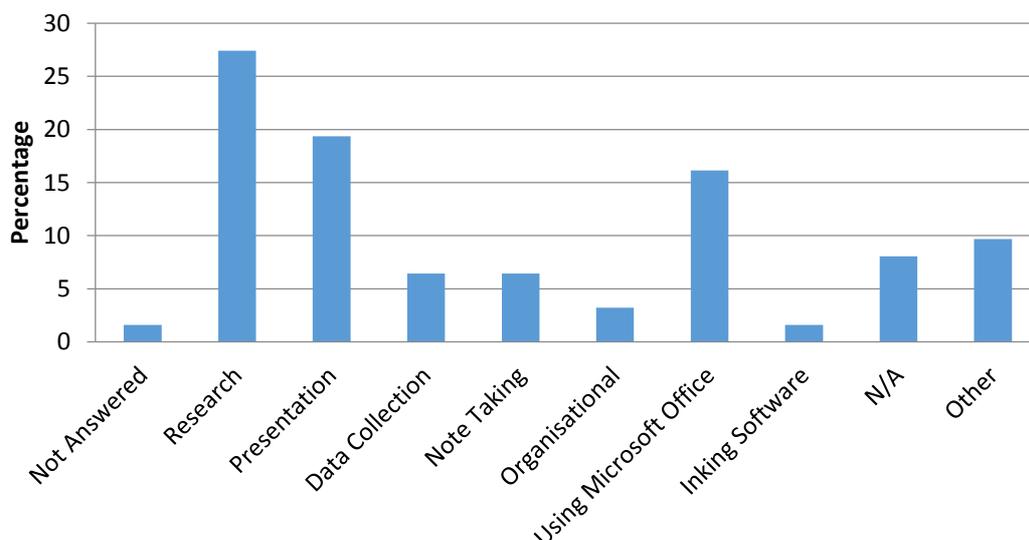


Figure 4.10. The most effective use of the Tablet PC in the classroom (Question 6d)

The questionnaire asked teachers which tasks were simpler to complete when using a Tablet PC and the results indicate, as can be seen in Figure 4.11, over 25% said N/A, indicating that these teachers did not use the Tablet PC in the classroom. The remaining teachers indicated a wide variety of activities that were made easier by using the Tablet PC, such as delivering content and internet research. They were very individualist in their responses. The even spread of responses may have been a result

of the staff not successfully distinguishing between Tablet PC and traditional Notebook features.

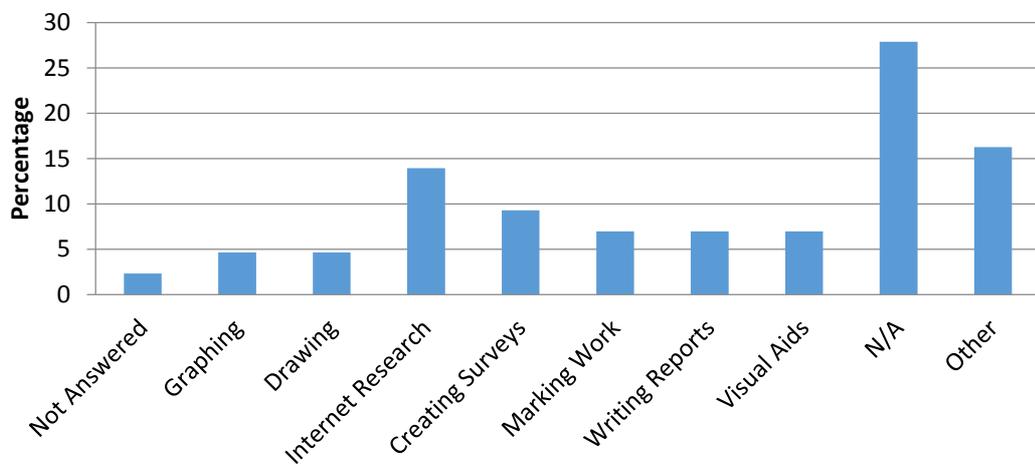


Figure 4.11. Tasks that are simpler to complete when using a Tablet PC (Question 6f)

As is evident in Figure 4.11, there were a number of tasks that could have been done with either a Tablet PC or the Notebook: graphing, drawing, internet research, creating surveys and writing reports.

Interaction

The questionnaire asked teachers to respond to how they felt when supporting students using Tablet PCs and the results in Figure 4.12 stated specify that the majority of staff felt comfortable (51%) confident (18%) or excited (8%) about the use of Tablet PCs in the classroom and when supporting students in using Tablet PCs. This indicates that they were happy for the Tablet PC to be used in the classroom. While most teachers stated that they were happy when using the Tablet PC, 18% did say they were worried.

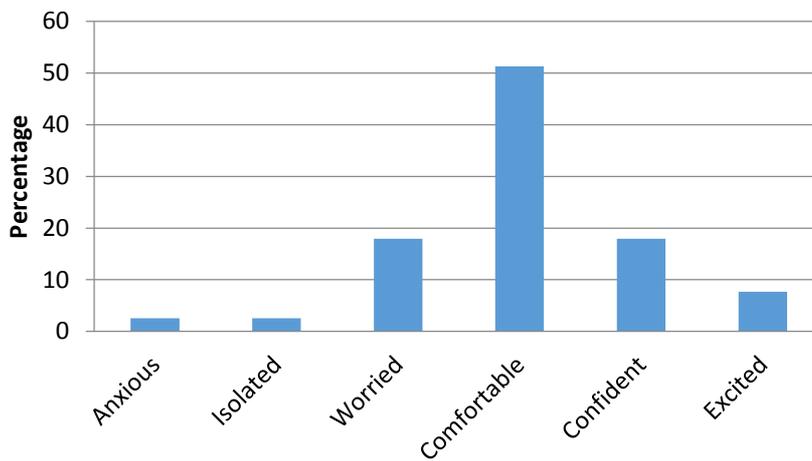


Figure 4.12. Teacher feelings when supporting students using Tablet PCs (Question 4)

The questionnaire asked teachers to identify how often they used a number of strategies in their classroom (see Table 4.1). The results show that, while in the majority of the classrooms the students had their own Tablet PC, they were only required to use the Tablet PC “on occasions” (31%) or “never” (28%).

Table 4.1. Student use of Tablet PC in teacher classes (Question 2)

How often in the past year have the following strategies been used?	Each	Each	On	Never
	Week	Fortnight	Occasion	Never
	%	%	%	%
(a) Each student uses a computer in a laboratory	15	0	8	77
(b) Each student uses a Tablet PC in the classroom	36	5	31	28
(c) Students work in pairs with Tablet PCs	8	5	48	39
(d) Students work in groups with Tablet PCs	8	5	46	41
(f) Students use Tablet PCs outside of class time	33	18	26	23

The questionnaire also shows that teachers did not complete a lot of group work with their students and the Tablet PCs, with “on occasion” and “never” selections being responsible for greater than 87%, for both students working in pairs or in groups with Tablet PCs. This suggests that the majority of staff were not using the Tablet PCs in the classroom. Respondents indicated that they perceived their students were only using their Tablet PCs for the stated activities “on occasion” or

“never” for the majority of the time. This has been summarised in Table 4.2, as can be seen teachers (36%) believed that their students used the Tablet PC to access and store information each week, whereas 46% stated their students type assignments only “on occasion”. This indicated that the teachers believed that while the students were using their Tablet PCs to gather and store information on a regular basis they were not using the Tablet PC to manipulate that information.

Table 4.2. *What students used the Tablet PC for (Question 3)*

Tablet PCs are used by my students to ...	Each	Each	On	
	Week	Fortnight	Occasion	Never
	%	%	%	%
(a) illustrate a concept	15	10	36	39
(b) type assignments (e.g. word processing)	21	13	46	20
(c) access information	36	13	28	23
(d) analyse information (e.g. statistics, graphs)	23	8	28	41
(e) present information (e.g. publishing, slideshows)	21	5	51	23
(f) store information	36	10	31	23
(g) simulate an environment or action	5	5	28	62
(h) make a product	3	5	39	53
(i) develop a skill (e.g. typing, tables)	15	15	13	56
(j) provide a problem	0	18	13	69

Pedagogies being used with the Tablet PC

As can be seen by Table 4.3, staff did not believe the Tablet PC in the classroom benefited the students nor increased educational outcomes, with the majority of responses contained within in the “on occasion” or “never” columns. With 58% of responses for “student learn more quickly” and 50% for “students complete more work”, “students enjoy learning” come from the “on occasion” column.

Table 4.3. Frequency of outcomes evident when Tablet PC was used (Question 5)

When students use Tablet PCs in your class how often are the following outcomes evident?	Each	Each	On	
	Week	Fortnight	Occasion	Never
	%	%	%	%
(a) Better understanding of curriculum content.	8	25	45	22
(b) Students think in different and interesting ways.	14	11	49	26
(c) Students learn more quickly.	11	6	58	25
(d) Students help each other.	25	14	42	19
(e) The teacher’s time is better used.	17	11	44	28
(f) Students complete more work.	17	8	50	25
(g) Students enjoy learning.	25	11	50	14

In the questionnaire teachers were asked how they decided when to use the Tablet PC to support learning. The teachers responded (see

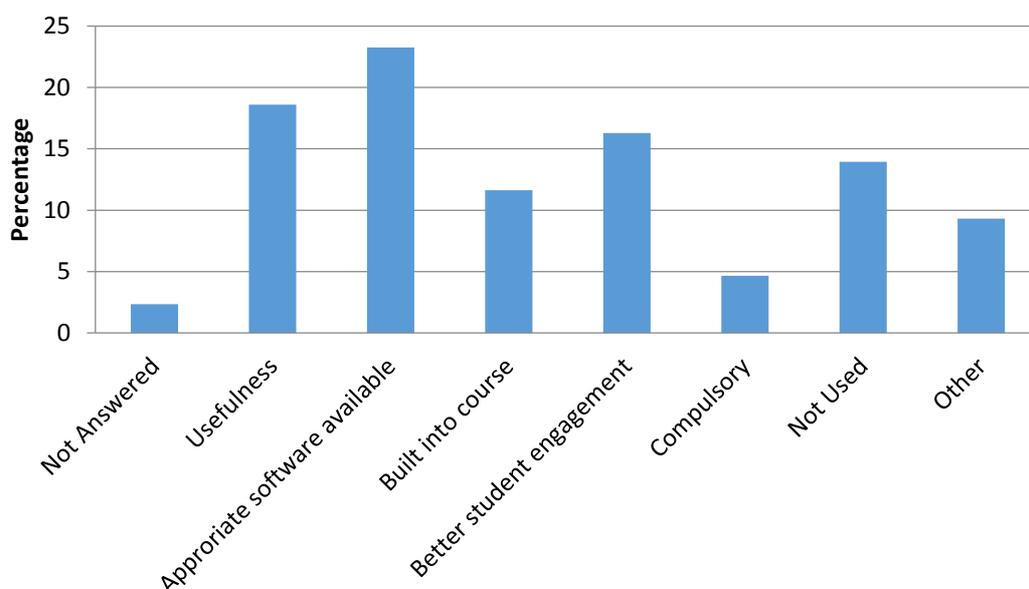


Figure 4.13) that they made decisions on when to use the Tablet PC when they felt it was a matter of “usefulness” (14%) and “better student engagement” (16%). There was a large range of other decisions suggested such as – when resources demanded it and looking at concepts from a different angle. However, there was no indication as to what “usefulness” or “better student engagement” actually meant nor was it evident that teachers understood how the use of the Tablet PC could support the students’ learning.

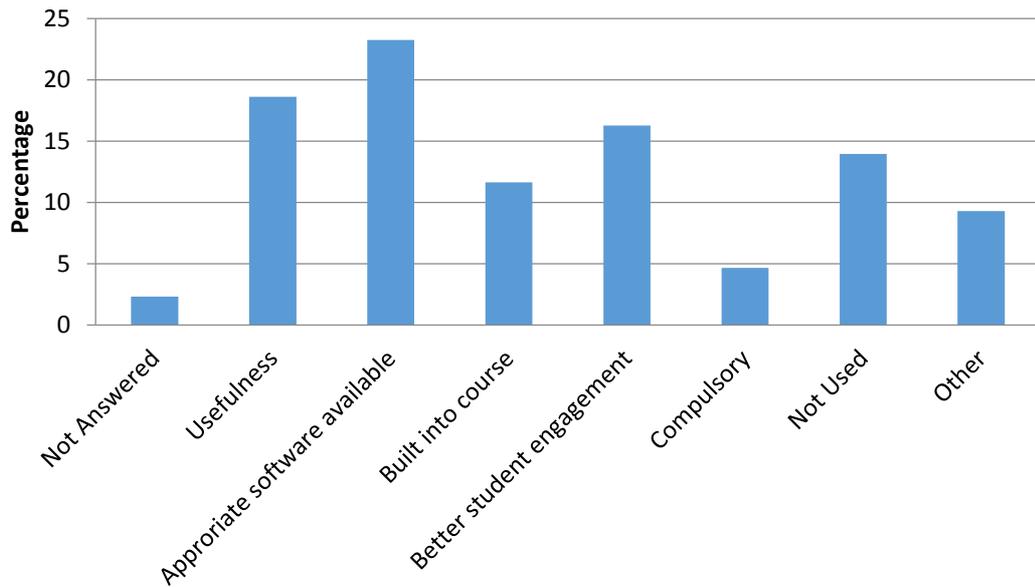


Figure 4.13. How the teacher decided when to use the Tablet PC to support learning (Question 6c)

The questionnaire asked the teachers if they had made changes to their teaching style as a result of having a Tablet PC, while the questionnaire responses indicated (see Figure 4.14) that staff did make changes to their teaching style as a result of having a Tablet PC (75% of staff said 'yes'). There was no indication of the detail as to exactly what and how they had changed.

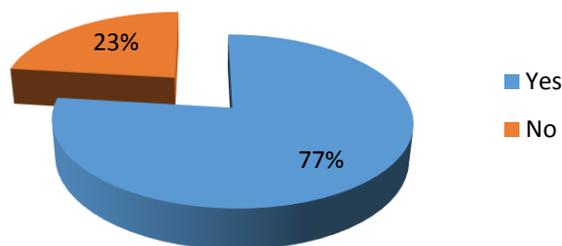


Figure 4.14. Staff changes to teaching style as a result of teacher having a Tablet PC (Question 9a)

Results of Figure 4.14 can be compared with a similar question from the questionnaire "did you make changes to your teaching style as a result of both teacher and students having Tablet PCs?" (see Figure 4.15), where 64% of the staff stated that they had made changes to their teaching style as a result of both the

teacher and students having a Tablet PC. This indicates that teachers were happy to alter their teaching style, although many could not articulate exactly how their style had changed.

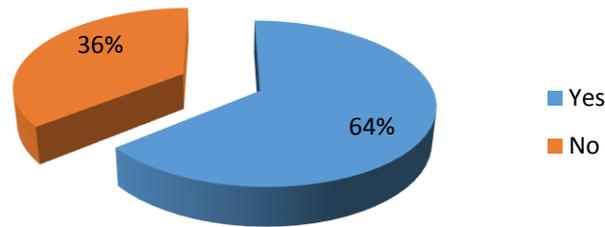


Figure 4.15. Staff changes to teaching style as a result of both teacher and students having Tablet PCs (Question 9b)

The questionnaire asked the teachers what the teaching style changes were as a result of the staff having a Tablet PC. They responded (Figure 4.16) with, the staff had moved to a more digital environment, with less writing on the whiteboard and more digital content used. Although a significant number of teachers stated that there had been no change as a result of them having a Tablet PC, this could have been due to the staff member not using the Tablet PC for its unique features or being unaware of its capabilities.

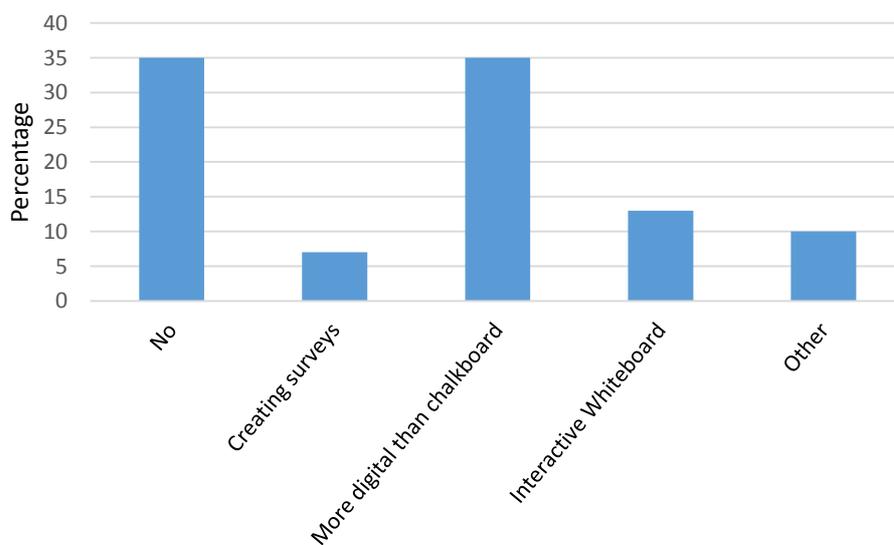


Figure 4.16. Teaching style changes as a result of staff having a Tablet PC (Question 9a)

As a result of the questionnaire asking the teachers, “what were the teaching style changes as a result of both teachers and students having a Tablet PC?” Figure 4.17 shows the confusion between teachers considering that they had changed their teaching style with very broad suggested reasons; less chalk and talk as well as student usage. Over 20% also indicated that they did not change their teaching style as a result of having a Tablet PC.

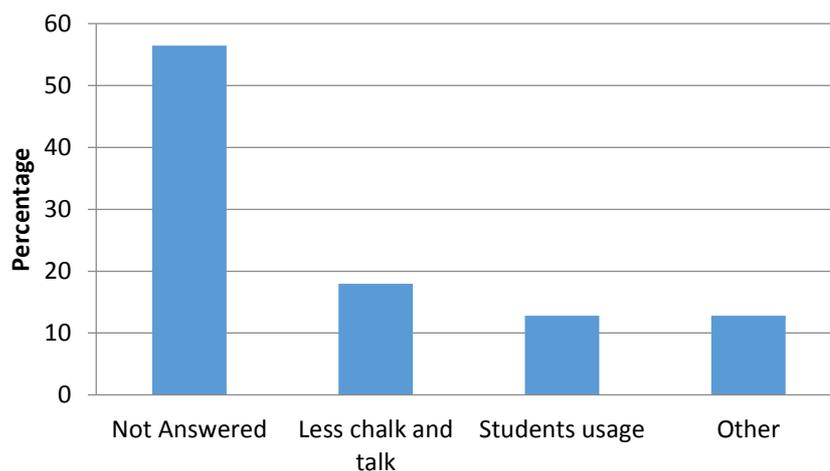


Figure 4.17. Teaching styles changed as a result of both teachers and students having a Tablet PC (Question 9b)

The questionnaire asked the teachers if the teacher contributed to the Tablet PC created planning and only 31% (see Figure 4.18) of the respondents actually contributed to Tablet PC-related curriculum planning. Examples of the ways in which they contributed were: designing learning activities that utilised computers; planning how to use Microsoft OneNote, Word, Excel and PowerPoint; and re-writing curriculum as electronic documents with hyperlinks. The results indicate that the teachers that responded either did not have an input into the curriculum development in their subject or they did not plan to use the Tablet PC.

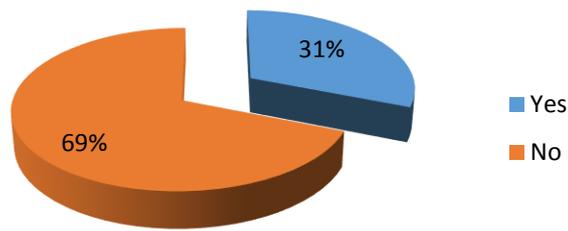


Figure 4.18. Does the teacher contribute to Tablet PC created planning? (Question 10)

Issues with Technology

Teachers were asked what was preventing them from effectively using the Tablet PC with the students. The staff responded with, lack of staff knowledge (19%), availability (13%) and student machines (34%), as shown by Figure 4.19. Staff indicated that their lack of knowledge of how to use the Tablet PC was an issue; they felt that they could not use the technology well because they did not know how to. Comments included; “lack of knowledge on my behalf”, “lack of ability on how to use it”, “my own knowledge and skill”, “my ability to use a Tablet and time” (Teacher Questionnaire). Teachers also claimed that the school had not given them enough support on how to use the technology, “there is never any PD on how to use the technology” (Teacher Questionnaire).

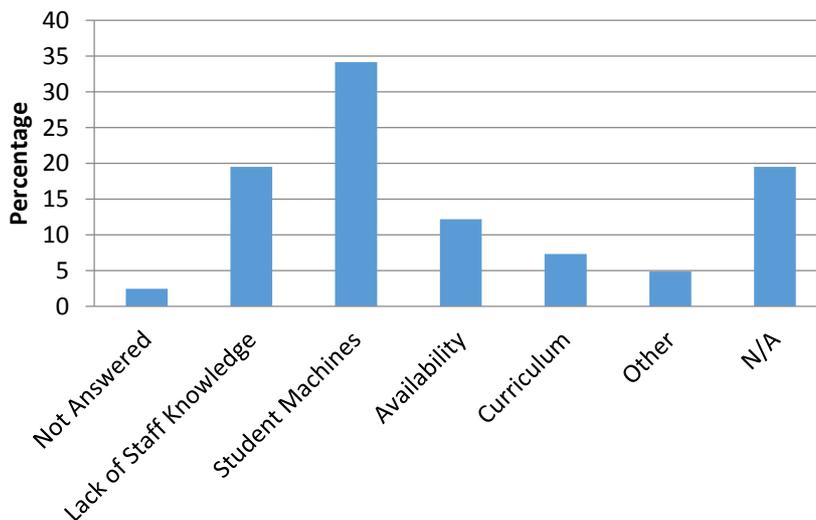


Figure 4.19. Issues that prevented effective use of the Tablet PC (Question 6g)

Teachers also stated that the equipment and technology within the school was a major issue in why they could not use the Tablet PC computer, “the wireless network is not reliable and they do not have access to a network port or network cable” (Teacher Questionnaire). Student machines were also stated as a major reason (34%) that blocked the staff from effectively using the Tablet PCs further. Issues related to the actual state that the students’ machines were in, and the fact that students were not always reliable and regularly left their Tablet PC at home.

The majority of reasons why the staff could not use the Tablet PC effectively with the students was that issues did not directly relate to the actual Tablet PC, but were general to the school, students and networking. These included lack of wireless connectivity and network ports, slow Internet, machines not working and students not bringing their machine to school.

Conclusion

Overall, the majority of the teachers that responded to the questionnaire had been teaching for a number of years and had been exposed to the Tablet PC technology for some time. They had competency in the use of the mainstream software types but few had used or experienced the Tablet PC specific software. It was apparent that many of the staff could not distinguish between the features of a Notebook and the Tablet PC, as many of the responses related more to general technology than specifically to the Tablet PC. Examples of this were when asked questions around the most effective way to use a Tablet PC or what tasks were made easier when using a Tablet PC, the responses were generalised and could easily have been responses for a Notebook instead of the Tablet PC.

A large number of staff indicated that they believed that having Tablet PCs in the classroom did not benefit the students nor give any greater educational benefit. Staff also indicated that they had changed their teaching style to suit the use of the Tablet PC in the classroom, but did not articulate exactly how this had occurred and only 31% of the staff actually contributed to Tablet PC related curriculum planning.

Early research (BECTA, 2004; Sheehy et al., 2005) indicated that one of the major draw cards for using a Tablet PC was the ability to use the inking capabilities to write; this was not evident at all in teacher responses. Only small percentages of responses indicated they either used or wanted to use the inking capabilities with their Tablet PC. Not one of the respondents mentioned using the “revolutionary” feature of converting hand-writing to text. This feature was supposed to be one of the key reasons for using a Tablet PC and its pen/inking capabilities.

One topic that regularly comes up in research around information technology devices was issues with the technology. Responses to this topic were very broad and rarely related to the actual Tablet PC technology. The major issue was the actual students’ machines, staff were always concerned that all their students’ machines were rarely in a workable state, so that they could run the lesson the intended way. Another major factor in preventing the staff from using the technology was lack of staff knowledge. This was made explicit with reference to a response in the questionnaire but was a common theme across a number of the other questions.

It was pleasing to note that in general, most staff felt comfortable with the Tablet PC technology being in the classroom, many just did not know how to use it to its full potential. Staff indicated a willingness to want to learn and highlighted two software types; DyKnow and Microsoft OneNote as software that they would like to investigate the use of further.

My impressions from the responses of teachers was that a large number of teachers did not actually know what the Tablet PC was capable of doing, therefore could not answer the questions in a way that helped the researcher. Further, if it is considered that the respondents were likely to be the more ICT enthusiast teachers then clearly across the school the availability of the Tablet PCs was having little impact on teaching and learning.

Teacher Interviews

The researcher handed out letters of invitation (See Appendix C) to ten participants with only six responding. The researcher interviewed all six teachers who responded. The initial invitations were not a totally random selection, as the intention was to try to get a range of teachers although this was limited by having only six teachers respond. All interviews were recorded using the audio facilities in Microsoft OneNote.

Table 4.4. *Participants' demographics*

Participants	1	2	3	4	5	6
Subjects taught	M,S,IT	M,S	M,P	H,E	M	E
Years teaching	25	18	3	4	6	7
Years teaching at this school	18	14	3	4	6	7
Years using Tablet PC with students	5	5	1	1	3	3
Years using Tablet PC for work related tasks	5	5	2	2	3	4

Note: M = Mathematics, E = English, S = Science, IT = Information Technology, P = Physics, H = History

In summary, the participants were from a spread of teaching experiences with a range of years' experience in the use of the Tablet PC both with the students and for work related tasks, as seen in Table 4.4.

The interview data was transcribed and analysed from the six participants for common themes, these being issues or subjects raised by more than one of the teachers. These issues or subjects could have been either positive or negative. There were eight 'themes' identified. These are summarised in Table 4.5.

Table 4.5. *Common issues arising from EoC Interviews*

Issues
Pen and Inking technology
Use of DyKnow monitor and recall feature
Use of Microsoft OneNote
Use of electronic worksheets for students to complete
Students did not always have their Tablet PC with them
A lot of down time in using the technology
Not enough support from the school
Continued investigation into ways to better use Microsoft OneNote and DyKnow

Each participant was allocated an EoC interview data score. This score was used to indicate teachers’ overall feelings towards their and the school’s use of the Tablet PC in the classroom. The score was generated from the cards placed on the “often” pile of the EoC sorting cards. Each card had a positive or negative value. Table 4.6 showed each participant’s total score between -20 and +20, the higher the score towards the +20 the more positive the participant’s experience.

Table 4.6. *Teachers EoC score between –20 and +20*

<i>Teacher</i>	<i>Score (Total possible +20)</i>
Teacher A	+12
Teacher B	+15
Teacher C	+8
Teacher D	+10
Teacher E	-3
Teacher F	-1

As can be seen, overall feeling towards the use of the Tablet PC was positive with four of the six teachers interviewed, scoring favourable on the + side. It was also interesting to note that the ‘Interested’ and ‘Pleased’ cards scored full marks across all six respondents.

Case Studies

As a result of analysing the teacher questionnaires and interviews, it was apparent that there were three main types of teachers using the Tablet PC. The data gathered for each of the three main types of users has been drawn from the Teachers' EoC interview scores (See Table 4.6), teacher questionnaires and classroom observations conducted on the selected teachers. Early Adopters: Teachers who had the skill and wanted to use the technology to the best of its ability. They went out of their way to research new initiatives and ways that technology could enhance learning. They had no issues with trying new ideas. This group was selected as a result of the EoC results of Teachers A and B with scores of +12 and +15 respectively, scoring high in feelings like Enthusiastic, Optimistic, Confident and Comfortable. Late Adopters: Teachers who really wanted to use the technology but either did not really know how or were not really willing to spend the time finding out. This group was selected because Teachers C and D obtained EoC scores of +8 and +10, scoring high in feelings like Interested and Pleased but not so high in Supported and Exhilarated. Reluctant Adopters: Teachers who did not want to use it at all and when they were told to use the technology, did not use it very well. This group was as selected as a result of Teachers E and F's EoC scores of -1 and -3, scoring high in Anxious and Frustrated but not in Confident and Comfortable.

Results of two questions from the teacher questionnaire also assisted in framing the three groups. Figure 4.2 indicated that a high percentage of staff (>55%) believed that they were not comfortable with allowing students to choose how to use the technology to assist in their own learning. Figure 4.3 indicated just under half (47%) were comfortable or felt confident enough to use the technology to support learning. Quotes from the EoC interviews and classroom observations have been included to illustrate the case studies. The case studies are for illustration purposes and represent an amalgam of characteristics that have come from more than one individual.

Case Study 1 Early Adopter (Jon)

Background

At the time of the research, Jon had been teaching Mathematics, Science and Information Technology for over 30 years, at the current school for over 16 years, and used Notebooks/Tablet PCs with the students for 15 years. He indicated that he was very comfortable with computers/Tablet PCs in the classroom and enjoyed using them.

Classroom setup

Jon generally set each classroom up the same way each lesson. Each room was set up with tables facing each other, at right angles to the front (see Figure 4.20). By having the tables setup in that specific way, it gave the students the ability to easily see the board, it also allowed for easy interaction between more students as they were sitting in fours. He also had easier access to be able to wander around the room and observe exactly what each student was doing. If requested, students could easily turn their Tablet PCs to the front of the classroom for him to see.

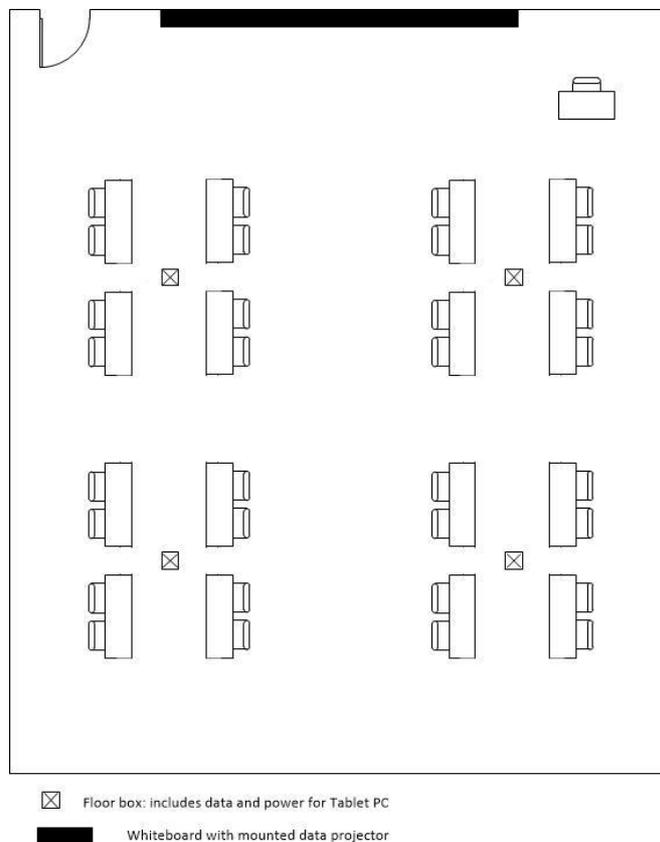


Figure 4.20. Typical setup of Jon's classroom

Jon had not needed to change the classroom set up that much, as he had been using Tablet PC/Notebooks in the classroom since they were introduced to the school in the late 90s. There had been a slight modification to the way the classroom was set up; tables moved closer to the board, especially with the increased use of a data projector and the Tablet PC, but the teacher was happy with the set up. Students in Jon's classroom liked to choose which mode they used their Tablet PC in (Tablet PC or Notebook mode); one reason for this was the students liked to use the short cuts on the keyboard (for example 'Ctrl C') as well as the pen. For this the teacher placed the most trustworthy students up the back of the classroom; these students did not need as much monitoring. Classroom observations indicated that at the most, 80% of the students used the Tablet PC in tablet mode for most of each lesson.

Implementation of lessons

Jon had modified a number of his paper based assessment tasks and class activities from the scope and sequence of his classes. Any tasks that could not be done using the Tablet PC were changed to suit the Tablet PC. For example, students recorded, via the pen and Microsoft OneNote, what was actually happening, while the teacher showed/described that lesson's topics. The students were then required to complete that task in OneNote using the pen technology.

Jon used Microsoft OneNote in a number of different ways. Subject area topics were created in OneNote (see Figure 4.21), Jon was able to create folders/subfolders and worksheets, so that students could work directly from the OneNote Notebook. This removed the need for students to have a written work book.

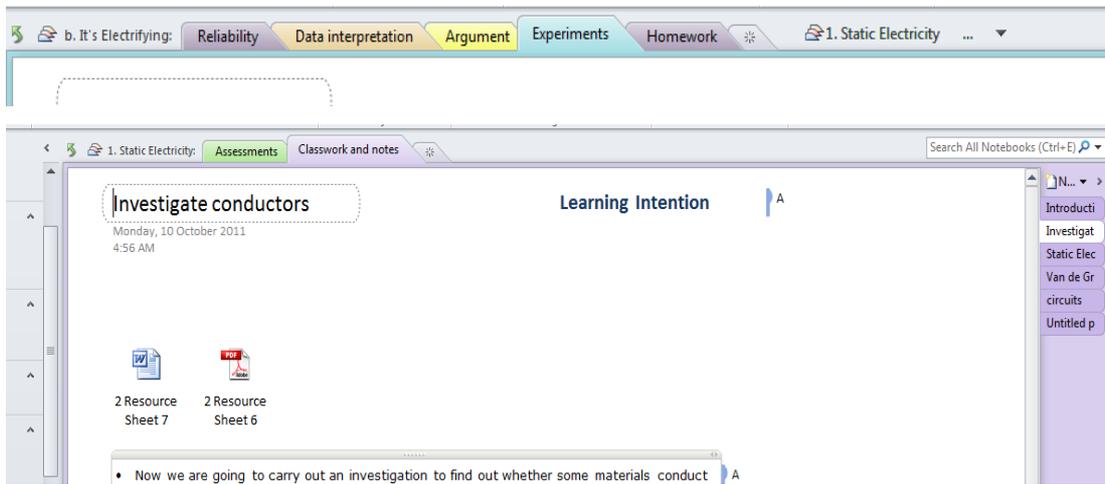


Figure 4.21. Sample screen shot of a student's notebook in Microsoft OneNote

The creation of the Microsoft OneNote Notebooks allowed both the student and teacher to be more organised, largely due to the ability to synchronise the OneNote Notebooks which allowed students to submit work without having to actually do anything as the files were always synced to the school's server.

As a result of the synchronised Notebook folders, Jon could then monitor exactly what each student was doing by simply clicking on the student's name (in the teachers Microsoft OneNote) and then navigating to the required section (see Figure 4.22). At the time of the study, Jon was using this with his Year 5 and 6 classes and was planning to expand to all year levels he taught.

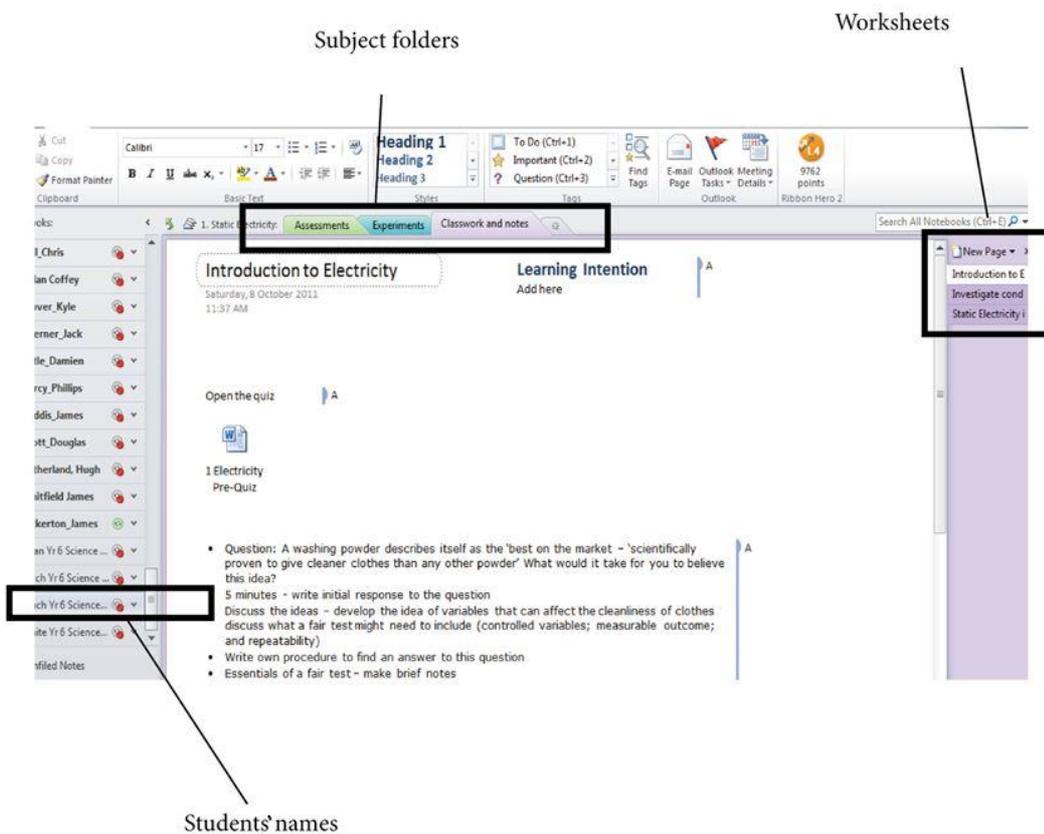


Figure 4.22. Sample of what Jon saw in his own Microsoft OneNote application

Sample lessons

Jon used his pre-setup Microsoft OneNote lessons and, integrating video into the worksheet, he was able to get the students to watch a video on the g-forces on the moon. They then (in the worksheet next to the video) showed the calculations on how to work out what the g-forces of the moon were.

Jon used the Tablet PC's inking capacities, incorporating Microsoft OneNote, to work through solutions on a shared OneNote sheet. Students took it in turns drawing on the Microsoft OneNote worksheet, completing a sequence of diagrams, to explain an important concept. Students were then able to easily make changes and have a greater understanding of the concept as they could all see what each student was doing, including any mistakes that students may have made. It also gave the students less chance of incorrectly copying the diagrams down as the completed final diagram could be saved and distributed to each student.

Jon also incorporated the Tablet PC's inking capabilities into students' practical reports. The students were able to easily draw diagrams for experiments, take a picture of the science apparatus, import into Microsoft OneNote and annotate using the inking technology. This reduced work time as students did not need to be spending valuable lesson time hand drawing with pen and paper.

Jon used DyKnow's ability to group students; this allowed students as a group to see and annotate a shared workbook, and for each group to record their experiment. Jon was then able to display each group's workbook for the rest of the class to see (e.g. Experiment – length of students' arm span).

Also, students were given a task working in pairs. They used the pen to show workings out, and each group of students was then able to display their task on the whiteboard via DyKnow. Students then explained why they had answered the question that way. Jon was then able to give control to other students in the class, so as they could contribute to the working out. At the end of the lesson, Jon collected each group's work, combined the working out and sent them back out to all students. Jon used DyKnow's polling ability to create multiple choice questions see (see Figure 4.23). Students then answered and all the students' responses were shown as a pie graph see (see Figure 4.24).

Bruce is cooking dinner.
The table shows the cooking times for his dinner.

	Cooking time
Chicken	1 hour 40 minutes
Potatoes	20 minutes
Peas	10 minutes

Bruce starts cooking the chicken at 5:10 pm.
He wants everything to finish cooking at the same time.
At what time should Bruce start cooking the peas?

Possible Answers:
A) 6:20 pm
B) 6:30 pm
C) 6:40 pm
D) 6:50 pm

Launch Poll

Figure 4.23. Multiple choice question created in DyKnow

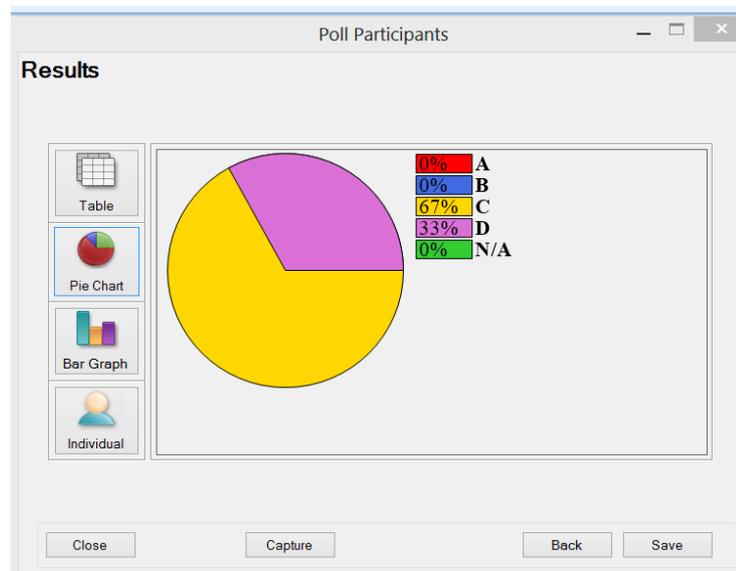


Figure 4.24. Screen shot of DyKnow's polling feature

In Year 7 Science the students were able, within seconds, using the Tablet PC pen, to animate the motion path of the water cycle quickly and easily with less fuss. Jon then displayed each student's work on the data projector for the whole class to see.

Features of Tablet PC

Jon used the pen and inking technology to mark student work and return it electronically back to students via the network. Jon used the network to give out and retrieve student work, he then marked the work on his Tablet PC using the pen and inking features of Microsoft Office (Word, Excel, PowerPoint and OneNote) easily commenting on each section of the students' work. The annotated work was then returned to students via the intranet. Jon stated that, "Day to day work is done 99.99% via network to laptops. Returned back to me electronically, I use the Tablet PC and pen to mark the work and return it to them via the network".

It was stated by Jon that the inking features of software assisted students with improving their hand writing, allowing them to write notes and easily delete mistakes or make corrections without the page being messed up as it can become with the traditional pen and paper. Also, a number of students was able to produce better more literate work by using the pen features of the Tablet PC, "some of my students

are not the best writers using a conventional pen or the fastest typists, the Tablet PC pen and inking capabilities enabled them to work faster and more efficiently”.

Jon used Microsoft OneNote to create lessons (see Figure 4.25). With the early year levels (Grade 5 and 6) he set up a Microsoft OneNote Notebook that was common for all students. The Notebook consisted of a number of tabs/headings – key headings relating to the topic or assessment, homework and assessment tasks. Each heading was then broken up into more detailed aspects. Each student’s Microsoft OneNote Notebook was synchronised to the teacher’s OneNote application via the school’s server. This gave the teacher the ability to see exactly what the student had done. This was used in the classroom as instant feedback to what students were doing as well as giving the teacher the ability to show student work on the data projector.

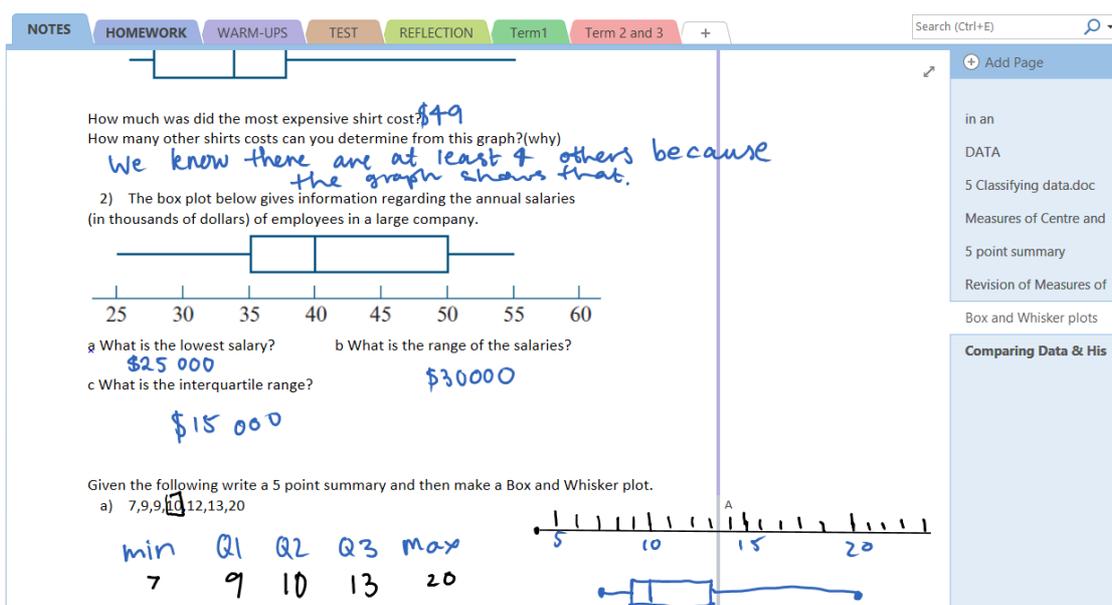


Figure 4.25. Sample screen shot of student work in Microsoft OneNote

Microsoft OneNote shared connection with student groups, gave the students the ability to see each other’s work. This allowed the students to easily carry out peer assessment.

DyKnow was used to gather instant feedback about students. Jon used the features of DyKnow to create multiple choice polls to gather instant feedback on how the students were going on a particular concept or topic (see Figure 4.24). Jon also used DyKnow to monitor student progress using the monitor feature of DyKnow group work and peer assessment were completed via DyKnow's ability to group students and gave the students in each group control over each other's DyKnow worksheets so that group work and peer assessment could be done. Jon retrieved students' work panels from DyKnow; this allowed the teacher to get student work without the students having to do anything and reduced the chance of students not submitting the work.

Interaction - Teacher/Student

Jon, via either Microsoft OneNote or DyKnow, was able to give instant feedback to his students. He was able to collect student work instantly, see exactly where they were up to and comment via the Tablet PC's inking capabilities. He was also able to check student work via DyKnow monitoring or shared worksheets in OneNote. He did not have to leave his desk or the front of the room to observe or give feedback to his students. Jon stated that there was now more interaction with the students, through chat, email and talking to the students, "the students are now more engaged in the lessons and the teacher because of their interest in the technology".

Interaction - Student/Student

Students did peer to peer assessment with ease using the Tablet PC; this was done one of two ways. As students were sitting in groups of 4, it was easy for them to share their Tablet PC with each other on the table. The other way was for students to be placed in groups either via Microsoft OneNote shared connection or DyKnow's group allocation feature. Students then had the ability to annotate each other's work. This same feature was used for student group work, students could easily see each other's work and annotate it using the inking technology.

Using DyKnow and the inking capabilities, Jon was able to give different students control of the worksheet displayed on the whiteboard. Students then showed the

rest of the class via annotating the worksheet, how they would have completed the questions.

Pedagogies being used with the Tablet PC

The Tablet PC gave Jon the ability to allow his students to easily share and record ideas with each other by handing the Tablet PC around to each other or by using the shared worksheet features of the Tablet PC based software types. The Tablet PC facilitated group work effortlessly, by allowing students to share their worksheets with other members of the groups by a simple click of a button.

Students used the Tablet PC as a Mini Whiteboard, a form of formative feedback (see Appendix E). The Tablet PC's software was an improved version of the Mini Whiteboards. Jon said that "On the Tablet PC the students worked samples could be easily saved. If you used the Mini Whiteboards, unless you are recording or taking photos, the student work is lost once you have rubbed it out". When Jon used the Mini Whiteboards for feedback, the students lost huge chunks of their lessons, as the student work was not being recorded. One of the biggest issues was that the weaker students could go a significant part of that lesson without recording any work, putting them further behind.

Jon was trying to use pedagogies that required students to be more independent and organised. He had a number of boys who had very messy writing and workbooks. These boys were always losing or forgetting their workbooks or worksheets. By using Microsoft OneNote, the students workbooks were a lot more structured, the students could easily find what was needed and they could not lose the Microsoft OneNote sheet; it was always on their computer and synced to the server. The teacher also noticed that the poor handwriting of a lot of students seemed to improve. Jon believed this was due to "the students' ability to be able to easily rub out mistakes or messy writing. They are more confident to write what they want".

Jon suggested that the Tablet PC feature had motivated the "disinterested" students by engaging them. Students were now more engaged and wanted to use the technology to learn.

Issues with the technology

Jon was concerned that with any shared lesson (using Microsoft OneNote or DyKnow) the students had access to each other's inked notes and was worried that if the students did not act in a responsible way, lessons could be sabotaged. Students, at times, rubbed out other students' notes or wrote silly things on each other's work spaces. His comments resorted to "some of you cannot be trusted, please leave other students' comments alone, I am now going to have to restrict the sharing to a select few".

Jon stated that many teachers were worried about the Tablet PC as they saw it as a distraction as they did not really know how to use the technology. Jon suggested that there were certain sections of the school that had taken the line that they did not agree that technology was needed in the school. Since the senior levels of their subject did not make use of the technology, there was no need for it further down in the lower year levels. They dismissed the Tablet PC technology and did not see that it was required in a student's education.

Jon stated that "while the teachers are not confused by the use of the Tablet PC technology within the school I believe that a number of staff are confused about the value of the technology and how to use it". Jon was concerned with the amount and quality of support provided by the school. "While you get some Professional Development, because there are certain people who are anti the technology that are allowed to create the policies, these policies clearly outline the lack of any technology. The amount of Professional Development that is needed is well below what is required". Jon felt that, due to this, there had been no focus on appropriate Professional Development.

The Tablet PC could be slow to start up, especially for students with older machines; this was a distraction at the start of the lesson when trying to settle the class down. Technology could be very isolating with individual students using iPods/computers/headphones. Students could easily live in their 'own world' on a computer. This was a problem for some students more than others, especially the

younger students. A number of Year 5 and 6 students spent most of their time on the computers before school, at class breaks and afterschool.

Jon was concerned about the technology not being available and in a state that was usable. Regularly Jon went to use the technology and not all the students' machines were working properly or were at Notebook Support Centre. This meant that the actual task Jon had planned could not always be implemented to the best of its ability.

At the older year levels, a Tablet PC was not compulsory so many students bought their own devices; most did not have the Tablet PC capabilities. To get around this, a class set of Tablet PCs was available to book. The teacher made note that this was not ideal as they could not guarantee that all the Tablet PCs in the trolley would always be working, many had flat batteries and a lot would not log into the network via wireless. This was an issue since most classrooms in the science areas were very limited in wired access points. The teacher had to regularly plan for the technology to not be working. Jon recommended that if the technology is not working, teacher should always have a backup plan, usually the textbook.

Future use of the technology

The teacher would have liked to have explored the use of DyKnow to a greater level than he previously had, he could see the benefits in using some of the features. He had only touched the surface of its ability. He would have liked to have investigated a lot more group work and a number of features of DyKnow that he had only read about. He would also have liked to have explored the use of OneNote and gaining access from home, so as students could get instant feedback from their teacher at certain times of the week.

Summary

Jon was very optimistic that the use of the Tablet PC would move forward and be used more often in more classrooms as it became clearer that the Tablet PC technology was very useful. "Especially in the outside world – outside of education,

this technology is being used more and more in the general public. Education needs to take up the technology that is being used in the outside world and teach our students how to use this technology to the best of its ability”.

He was very enthusiastic about any sort of technology, especially the Tablet PC, and was excited about what this technology could and would do for education. Jon claimed that students had a lot of enthusiasm when using the technology “actually at times I had to calm the students down”.

Jon believed that the staff really only used the technology that was shown to them, not many teachers were using their initiative and going out and researching what else was out there. They were relying on the school to provide them with the “how to use” manuals.

Case Study 2 Late Adopter (Barry)

Background

At the time of the research Barry was teaching Yr 5 to 9 Mathematics and Yr 12 Physics. He had taught overseas, had been teaching for a while and was new to the school.

Classroom setup

Barry’s classroom set up was very similar to the way he used to teach without the Tablet PC, (see Figure 4.26). Students sat in rows facing the front, a typical school classroom setup. The main difference was that he was more selective about who sat with whom. Barry was worried about the influence that some students may have had on other students and the fact that if they sat together they may not have used the Tablet PC as effectively as they could have.

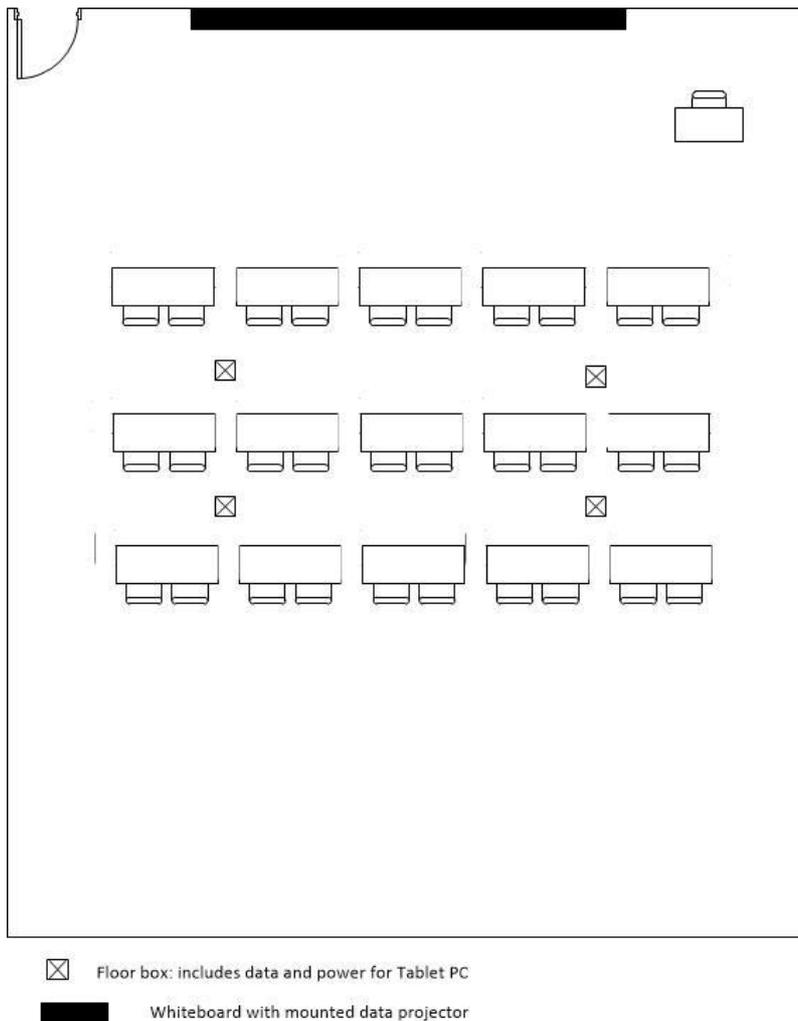


Figure 4.26. Typical setup of Barry's classroom

Implementation of lessons

Barry gave his students a PowerPoint file with a number of revision questions on it (see Appendix D). Students answered the questions using the inking capabilities of the Tablet PC. Students either worked individually on Microsoft PowerPoint or in groups situated around one Tablet PC, with all students using the Tablet PC and pen to contribute to one PowerPoint file.

Barry regularly stopped the class and connected one student's Tablet PC to the data projector. The class then commented and worked through the student's work. The teacher would annotate the PowerPoint with the Tablet PC pen and inking capabilities.

Barry used DyKnow for revision lessons in a very similar way to that of PowerPoint. Barry set up a number of revision questions in DyKnow and, using DyKnow monitor, he was able to see students' progress easily. As part of the homework process, Barry then used the pen and inking technology of the Tablet PC to mark student work that was submitted via the school's network and In/Outboxes.

Features of the Tablet PC

DyKnow provided the ability to write down worked solutions instantly and collect the work instantly, using DyKnow's recall ability. Barry was then able to give feedback on the workings, either while the class was going or at a later stage.

The pen inking technology provided the ability to ink onto a document. Students used the pen/inking technology to write on documents/worksheets on the computer using either Microsoft OneNote or DyKnow. Also, Barry marked students work using the pen technology. Use of the Tablet PC pen for inking allowed students to easily show mathematical workings out. It was a lot simpler and easier to do this with the Tablet PC, pen and inking technology - less messy and far easier for both Barry and students to understand. There was not as much crossing or rubbing out and students' work spaces were subsequently a lot neater. Barry could then easily display each student's work on the board for everyone to see. This feature was used a lot and had excellent outcomes for the users.

Interaction - Teacher/Student

Barry believed that interaction between teacher and student had changed very little with the introduction of the Tablet PC; if anything, there was less communication when the students were doing their work as they were more interested in what they were working on while using the Tablet PC. He believed that the Tablet PC could easily isolate the students from participating in the lesson.

Interaction - Student/Student

Barry believed that there was less interaction between the students; students were more focused on what they were doing on their Tablet PCs than what each other

was doing. Students at times helped each other using the inking pen to write answers on each other's Tablet PC. Students also sat around one Tablet PC and completed revision questions, sharing the input, giving their own ideas and responding via the inking pen of the Tablet PC.

Pedagogies being used with the Tablet PC

DyKnow allowed Barry to give instant formative feedback on how students were going at a particular point in time. He was able to select an individual's slide and annotate the slide instantly. The students could then see exactly what he was saying. This was now a lot easier, less time consuming and more immediate. The students got their feedback in a timely manner.

Barry had indicated that he used the Tablet PC so that students could become more independent and organised, especially boys in Years 7, 8 and 9. "If you are handing out worksheets, they could be (strewn) throughout their locker, on the ground or wherever". This made it very hard for students with poor organisational skills to revise for tests or complete their homework. To have the files on the computer and do the working out using the inking technology meant that the worksheets and/or homework were always on the students' machines. The prospect of the students losing their work was greatly reduced as they could easily retrieve the work from their Tablet PC. Students could refer back to their notes if there was an excellent worksheet that had questions that would help the student focus on an upcoming test or assignment; the worksheet was there for them to easily access. This helped the disorganised students two fold; firstly, they actually had the document on their Tablet PC, not in their locker or bag, and secondly, it also reduced wasted time, by stopping them from, having to leave class to look for it.

Use of the DyKnow monitor allowed Barry to easily and quickly monitor what students were working on from the front of the classroom. "Very hard to get around the room and see all students' work, DyKnow gave me the ability to quickly and easily see each student's screen. I could then react quickly to any issues that arose". Barry

was able to give instant feedback to his students, any concerns could be rectified then and there.

What could be done on the Tablet PC could be done more efficiently in developing the student's learning. For example, with certain measurement activities, students were encouraged to use the Tablet PC designated programs or the use of the pen/inking technology instead of with pen and paper. "Pen and graph paper can get very fiddly and messy by hand with lots of mistakes. Tasks can be lost on the students. The pen/inking technology makes life a lot easier for the students".

Issues with the technology

At the time of the interview there were a number of Year 9 students who did not have a Tablet PC. With the initial introduction of the Tablet PC into the school, there was a time that the Tablet PC was optional (20% of students did not take up the offer of the Tablet PC, instead purchasing a traditional Notebook). Barry stated that he was very frustrated by the fact that not all students had a Tablet PC in his classroom and this was a hindrance for when he wanted to do Tablet PC based activities.

Barry also stated that he would have liked more support in the use of the technology. At times, he felt that the school was happy for him to use the technology but not give him time and advice on what direction he should go. He stated that, "if the school is going to invest large amounts of money into the Tablet PC program, then they also need to invest time in training the staff on how to use and implement the Tablet PC".

Students did not always bring their Tablet PCs to class every lesson; this was an issue if lessons had been specifically designed to use the Tablet PC. Students either needed to go and borrow a Tablet PC or miss out on the learning within that activity. This was also very disruptive and distracting to the learning of other students.

Students spent a lot of time on their computers in the classroom. Barry believed that this was sometimes a good thing as they were concentrating on their work, but it

would have been good if at times they had more interaction with each other. They did not do this when using their Tablet PCs.

Barry stated that at times the students were too reliant on the technology; many lost their way with using the technology, instead of doing the tasks the most effective way (some tasks could be better done by hand). Students and teachers needed to choose the appropriate technology for the right task. Barry indicated that this was not always the case.

Barry stated that certain tasks led to a lot of down time with the students. Students appeared to lose direction, were easily distracted and not focused on the task. The Tablet PC appeared to be the cause of this.

Students' Tablet PCs did not always work the way that Barry wanted. Some students' Tablet PCs were very slow to start up or were missing the pen used to ink with. This caused delays and sometimes a need to change the way the lesson was taught. Barry suggested that more time needed to be spent on educating the students on how to care for their Tablet PCs. If he had all the students' Tablet PCs working all the time, then his classes would run more efficiently.

Future use of the technology

Barry could see that the Tablet PCs had huge potential to help boys in the classroom and would have liked to have seen where the technology would take the school. "There are a lot of boys who are disorganised, lose lots of their work. I think that this is a way forward for most of these boys." The teacher would have liked to have investigated and explored ways in which the Tablet PC technology and the network could have helped students be more organised.

Barry would have liked to have investigated how to use a number of the features of Microsoft OneNote to better enhance the learning of his students. While Barry had not used Microsoft OneNote, he had heard a lot of great things about the software

and would have liked to have seen what it could do. He felt that he did not have enough time and skill to spend on developing curriculum that used the Tablet PC.

Summary

Barry acknowledged that he did not use all the technology that was available to him, mainly due to time and skill, he also stated that the Tablet PC features used were centred on the students using the Tablet PC. There was not nearly enough interaction between the Tablet PC technology, the students and his teaching methods. Barry indicated that the school did not invest enough time and effort into supporting the staff in using the Tablet PC and if this increased, his use of the technology would also. There was the perception, from teachers, that at times students were not as engaged as they should have been. Barry felt that if the teachers were enthusiastic with the use of the Tablet PC technology the students were going to be more enthusiastic about learning. For this reason he perceived that the Tablet PC was a really useful learning tool.

Case Study 3 Reluctant Adopters (Gayle)

Background

At the time of the research, Gayle was a young teacher, who had only been teaching for a few years and had no experience with Tablet PCs in the classroom. Gayle indicated that she did not really understand the difference in features between a traditional Notebook and a Tablet PC. Many of Gayle's comments were very general and could have been implemented using either a Notebook or Tablet PC.

Classroom setup

Gayle stated that the classroom setup when using the Tablet PC computers could be different to her typical classroom setup, especially in the science rooms. Setup really depended on where the power and data points were placed in the classroom. If there was data/power in floor boxes, then the students were grouped around these (see Figure 4.27), but if there were no floor boxes, the traditional classroom set up was implemented (see Figure 4.26). At the time of the research the school was having

issues with the wireless access within the school so there was a greater need to physically connect to the network.

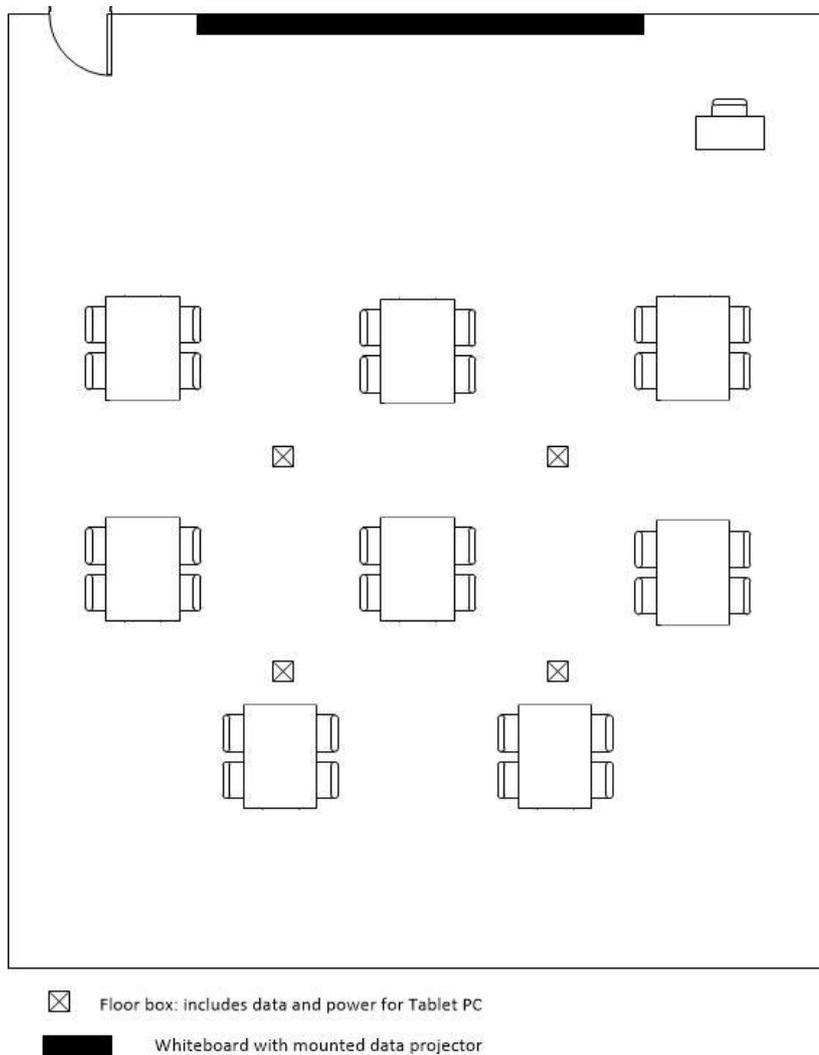


Figure 4.27. Typical setup of Gayle's classroom

The actual physical set up of the classroom was more of a determiner than whether the students were using a Tablet PC or not. In many cases, how the classroom had been left from the previous lesson was also a factor. There was no concerted effort to have the classroom setup in a particular way.

Implementation of lessons

Gayle attempted to implement paper free Science lessons. She set up worksheets electronically; students retrieved and submitted their work via the teacher's Inbox/Outbox; students completed worksheets on the Tablet PC; and most

worksheets were designed for use with the Tablet PC pen. The teacher also setup a Microsoft OneNote template and got students to complete tasks using this. Students retrieved and submitted the OneNote file via the teacher's Inbox/Outbox.

Gayle created Microsoft PowerPoint presentations to display questions on the screen via a data projector. The teacher then used the Tablet PC pen to write the solutions or show the students the correct steps to solving the questions. Students could immediately see how the solution was arrived at. Gayle used DyKnow to setup lessons that allowed the students to complete questions/tasks and then either had the students submit the tasks or collected them via DyKnow's collection feature.

Features of the Tablet PC

Using the pen capabilities, Gayle marked students' work and then handed it straight back. She set up Microsoft OneNote notebooks that allowed the students to use the Tablet PC pen features to complete worksheets. She also used software like DyKnow to collect student work, which made it easy for her not to lose the students' work.

Interaction - Teacher/Student

The dynamics of the class changed when using the Tablet PC in the classroom. "When a student has a textbook in front of them, I can tell if they are working or not. If they have a screen (Tablet PC) I have no idea what they are working on". Classroom observations indicated that the teacher really had no structure as to how the lessons were run. The interaction between the teacher and the students seemed to be of a maintenance type. The teacher was spending a lot of her time checking to see if each student was on task or not.

Interaction - Student/Student

Students completed peer-assessment by sharing each other's Tablet PCs; students would write using pen technology on each other's Tablet PC worksheets. This was a feedback assessment that was new to the teacher. The students' responses were what the teacher had expected as they enjoyed writing on each other's Tablet PCs.

Pedagogies being used with the Tablet PC

Gayle's comments were often that the lesson was great when the technology worked, but if something went wrong, she struggled to adjust to the situation and got very flustered. Gayle would go back to the office and discuss with other teachers what had worked and what had not. She acknowledged that the technology was more useful than just working from the book. The Tablet PC gave Gayle the ability to implement far more than just the questions out of a book. There were now other options, especially in Mathematics where the traditional method of working just from the workbook could be easily altered to implement more creative lessons including students collaborating, working in groups or sharing their knowledge via DyKnow or Microsoft OneNote. For example, Gayle tried using the Tablet PC and DyKnow to allocate student groups to do particular tasks. Once the students in the groups had completed the task, she would then display that group's work on everyone's screen to discuss. Using textbooks could be limited, if students finished a task earlier there was a lot more options with the Tablet PC; she could set up a number of individual tasks in DyKnow or Microsoft OneNote that catered for the individual needs of each student who finished early. Gayle, using the Tablet PC and DyKnow monitor, could easily keep track of what those students were doing, while interacting with the rest of the class.

Students were more engaged and enjoyed using the new programs with the Tablet PC, such as DyKnow and Microsoft OneNote. Students enjoyed using the pen for inking, the other end of the pen as the eraser. This made Gayle more enthusiastic about teaching and using the technology just as the students were.

Issues with the technology

Gayle believed that some students found it hard to organise their notes in Microsoft OneNote. "If they are disorganised in their books they will be disorganised in their computers". The technology did not solve these issues straight away. "Sometimes the technology worked and other times it did not...It is not from a lack of knowledge but more that I am not used to using the software...One lesson I decided to collect the students' slides myself instead of getting the students to submit them, which I

usually did. I got to the end of the lesson and half the students had shut their computers down before I got the chance to collect their slides, a lot of them had not saved their work so the data I wanted to collect was gone.” Gayle stated that “it was not the students’ fault but mine, there was no clear instruction”.

The DyKnow Monitor component was very slow at times and took a long time to load. It was felt that it was not worth using the feature unless the speed factor could be rectified. Sometimes a great lesson had been planned, using technology like DyKnow, and a number of the students did not turn up with their Tablet PC. That lesson could not run. Gayle explained that you had to either ‘think on your feet’ or plan a separate lesson that did not require the use of technology. She was concerned that if the trend continued, she would have had to create two lesson plans for each lesson, which was not a viable option.

Gayle indicated that she felt very isolated when using the technology and that there was not enough support to assist her in moving forward; she did not really know what she was doing and did not know how to go about doing it successfully.

Future use of the technology

Gayle wanted to continue with the use of DyKnow, integrating more of the DyKnow features into each lesson. The Science department had made a commitment to continue to use DyKnow. Gayle wanted to start using the synced notebook feature of Microsoft OneNote, so that she could keep track of student progress.

Summary

Gayle in this case study felt isolated with the use of technology in the classroom as Gayle was the only teacher in the year level using it. Gayle was confused as to what she was doing and how she was using the technology; it was very overwhelming. She could see the value of the use of technology in the classroom, she just struggled to use it effectively and to spend time learning how to use it.

Cross-Case Findings

Background

It emerged that the more experienced the teachers were, the more likely they were willing to try different teaching methodologies in relation to the Tablet PCs. For example, Jon had been teaching for many years and was extremely comfortable with the technology, was willing to try new ideas and was not concerned if something went wrong. Whereas, Gayle who had been teaching for only a short time, was not comfortable with the technology in the classroom and became very flustered when something went wrong.

Classroom setup

Classroom setup was different for each case study; the Early Adopters had a clear plan as to how the room should have been set up in each instance the Tablet PCs were being used. Students were placed in positions that got the most learning out of both the teacher and the students, as well as having an understanding of where certain students should have been seated or not seated to get the best out of everyone. The Late Adopters, while they did not change the physical layout of the classroom as a result of using the Tablet PC, had a thought process as to where students should sit, but this was more of a crowd control concern than strategic learning decisions. The Reluctant Adopters had no thought process for a seating plan; classroom setup depended on how the room was already set up, and, if the classroom had floor boxes, then they were used. Otherwise, it was wherever the students sat.

Implementation of lessons

The Early Adopters were clearly comfortable with implementing a number of different techniques in using Tablet PCs in the classroom. They were also willing to let the students be involved in their learning and the use of the Tablet PC. Examples of this were:

- Using the Tablet PC's inking capabilities, incorporating Microsoft OneNote to work through solutions on a shared OneNote sheet. Students took it in turns drawing on the sequence of diagrams to explain an important concept. Students were then able to easily make

changes and have a greater understanding of the concept as they could all see what each student was doing, including any mistakes that students may have made.

- Incorporating the Tablet PC's inking capabilities into marking students' electronic work. The teacher marked the student work and then electronically returned the work via the school's network.
- Using DyKnow's ability to group students (the feature allowed students as a group to see and annotate a shared workbook). Each group recorded their work. The teachers were then able to display each group's workbook for the rest of the class to see.
- Using Microsoft OneNote as the syllabus, lessons and content stored in Microsoft OneNote notebook files. Students did not need to have written or typed up notes, all notes were embedded in the file via the Tablet PC technology of inking. There was no need for a textbook as all content could be stored in the Microsoft OneNote file. These files could also be synchronised with the school's file server so that all students' Microsoft OneNote files were backed up.

Both the Late Adopters and Reluctant Adopters were less successful, although willing to try different techniques. Both made attempts to try to implement a number of software types including Microsoft OneNote and DyKnow. The Reluctant Adopters were not confident to move forward any further than the basics of Microsoft OneNote.

The Late Adopters and Reluctant Adopters used Microsoft PowerPoint with a number of slides to inform and educate the students. The teachers and at times the students would use the pen/inking technology to annotate the slides.

They also attempted to use DyKnow in a very simplistic way. They used the monitoring component of the software to easily keep track of what the students were doing as well as to retrieve students' worksheets to collect worked solutions the students had completed.

Features of Tablet PC

All three groups of teachers recognised that the pen inking technology (ability to ink onto a document) was beneficial. They all gave out and retrieved student work, then marked the work on their Tablet PC using the pen and inking features of Microsoft Office (Word, Excel, PowerPoint and OneNote), easily commenting on each section of the student work. The annotated work was then returned to the students via the intranet and their In/Outboxes.

All groups attempted to use the Tablet PC features of Microsoft OneNote. While both the Late Adopters and Reluctant Adopters only scratched the surface, it was the Early Adopters that really brought the best out of the software and used the Tablet PC features in the manner for which they were designed. The Reluctant Adopters only used the software like it was a note pad, while setting up worksheets in Microsoft OneNote. They only used the pen/inking features so that the students could record their own thoughts on the pages, with the occasional correction of student work. You could see that the Late Adopters wanted to use the features but, for various reasons, were not able to implement it in the classroom and were left with very similar outcomes to that of the Reluctant Adopters. Whereas, the Early Adopters were willing to extend their ability to use as many Tablet PC features as they could with Microsoft OneNote. They had set up complete units of work on the school's network so that the students could complete worksheets using Microsoft OneNote and the pen/inking technology. The students' work was synchronised to the school's network and the teachers' Microsoft OneNote workbook, which allowed the teacher to then electronically mark the students' work using the same technology the students had created the sheet in. This also allowed the teacher to instantly see exactly how the students were going. They then were able to give instant feedback via the pen technology and the students' OneNote page. Early Adopters used Microsoft OneNote's shared connection feature to create student groups where the students were able to use the pen and inking features to share work with each other.

Both Early Adopters and Late Adopters used a number of features of DyKnow to assist them in their teaching and the learning of students. Both used the shared worksheets

and ability to ink onto the worksheets to get students to complete tasks. They then were able to recall those sheets; the teacher would mark the students' work and send it back to the students. This was done either as a whole group or with individual students. The Reluctant Adopters only used the Tablet PC features in DyKnow for students to ink onto worksheets; the teacher would then collect the students' worksheets via the recall feature.

Pedagogies being used with the Tablet PC

The Early Adopters and the Late Adopters used features of DyKnow to monitor and gather instant feedback about students. They both also used the pen and inking technology to enhance the writing skills of their weaker students; the pen seemed to help the students with messy writing to become more confident. Early Adopters used the features of DyKnow to create multiple choice polls to gather instant feedback on how the students were going on a particular concept or topic. Early Adopters used group work, and peer assessment was completed via DyKnow's ability to group students and give the students in each group control over each other's DyKnow worksheets so that group work and peer assessment could be done.

The Early Adopters used Tablet PC features and techniques to instigate a number of formative feedback techniques that followed what the school was doing at the time. One of those involved the manipulating of a technique called "Mini Whiteboards" - taking the "Mini Whiteboard" and converting it to a worksheet on the Tablet PC. All three groups indicated that they set up electronic worksheets in the Tablet PC for the students to work through. This was partly an organisational decision, in that if the students had all their work in one place there was less chance of them losing it.

All three groups also suggested that using the Tablet PC was a way of more efficiently teaching. Simply using the textbook limited what could be done, the use of the Tablet PC and its features allowed for a larger range of activities to be created.

Interaction - Teacher/Student

Early Adopters used DyKnow Monitor for the ability to give a snap shot of where each student was up to. This saved the teachers time in that they did not have to ask the students or walk around the room to check where they were up to. Teachers also retrieved students' work panels from DyKnow; this allowed teachers to access students' work without the students having to do anything, reducing the chance of the student not submitting the work. They also suggested that the technology had increased the interaction between them and the students as the students had been more engaged in the technology. The students liked using the technology and were therefore more engaged in the lesson. Teachers could using the technology monitor student progress and as a result, give more frequent formative feedback.

Both the Late Adopters and Reluctant Adopters stated that there was not a lot of change in interaction between the teacher and the student, if anything there was less interaction and communication as the students were more engaged in their work; they were more interested in the Tablet PC and its features.

Reluctant Adopters stated that the dynamics of the room changed with the Tablet PC. Since the introduction of the Tablet PC, and the technology, the teachers had less of an idea as to what the students were actually doing; students were spending more time on the computer, but the teacher did not always know exactly what they were using it for.

Interaction - Student/Student

All three groups used the Tablet PC and its inking capabilities with the students in a number of ways. One of these included student peer assessment; this was completed at different degrees of complexity. The Early Adopters used two different methods. One was a rudimental way where students sat in groups and shared one Tablet PC between them; each student took a turn adding to the worksheet via the pen and inking technology. The other way set up groups of students using specifically designed software and allowed the students to share each other's worksheets. The

Late Adopters and Reluctant Adopters both used the rudimentary way of just sharing the one Tablet PC and got the students to each add to the worksheet.

The Early Adopters and Reluctant Adopters stated that there was increased interaction from student to student as a result of the Tablet PC and its features. For example, the ease with which the technology aided the teachers/students in conducting group work and peer assessment assisted in increasing dialog between the students. Whereas, the Late Adopters believed that there was less interaction between the students. They suggested that the students were more focused on the use of the technology and what they were doing with their Tablet PC than what the other students were doing.

Issues with the technology

All three groups stated that one of the biggest issues with the technology was that the students did not always have their Tablet PCs with them and that the students' machines that were in the classroom did not always work the way the teacher wanted them to or they were missing vital instruments like the actual inking pen. They also stated that there was, at times, a lot of downtime when using the technology. This could have been because the older machines did not start up quickly; the actual time taken setting up the lessons that were reliant on the technology was more significant; or because software like DyKnow could have been resource hungry. Another issue was that the Tablet PC was not compulsory at certain year levels so they came across compatibility issues at times when not all students had Tablet PCs.

All three groups made it clear that there was not enough support for the teachers and students in using the technology. A number of the staff were confused about the actual value of the technology and how to use it in the classroom. They felt that more needed to be done by the school to assist them. While the Early Adopters were happy to go out and find the help that was needed, the other two groups did not feel comfortable trying to find assistance on their own.

Early Adopters and Late Adopters both stated that technology could be very isolating and that the students could become too reliant on the technology, hence they were not sure that the technology was always being chosen for the right reasons. Early Adopters stated that they were concerned that a large number of staff saw the technology as a distraction and that was a reason why they did not want to implement it in the classroom. They also believed that, since the technology was not being implemented in the senior section of the school, this was filtering down to the lower sections. Reluctant Adopters were also concerned about the technology not always working and what to do if it stopped.

Future use of the technology

All three groups suggested that they would have liked to have continued investigating ways to better use both Microsoft OneNote and DyKnow. The Early Adopters stated that the reason why they did not continue investigating the software was that they could not allocate enough time to it. Both the Late Adopters and Reluctant Adopters suggested that time and their skill levels were the reasons why they did not follow through with using the software. Additionally, they also wanted to investigate ways of being more reliant on the technology as a learning tool within the classroom.

General comments

DyKnow is not an actual feature of a Tablet PC and has many features that do not need the use of the Tablet PC. Most staff mentioned that if they were not using the Tablet PCs and the Tablet PC features they would not have used the DyKnow software. DyKnow looked to be very good, but more Professional Development needed to have been done. The software could be very hard to set up and get working; it did not always work the first time; and all students' machines needed to be working properly all the time for the program to be functional in a way that was satisfactory in the classroom.

Summary of common trends across all areas

- Pen and inking technology was used by both teachers and students. Student work was electronically marked and submitted back to students either via the school's In/Outboxes, Microsoft OneNote synced files or DyKnow's recall features.
- Use of DyKnow monitor and recall feature were common.
- Microsoft OneNote was used to varying degrees.
- Electronic worksheets were used for students to complete.
- Students did not always have their Tablet PC with them.
- There was a lot of downtime in using the technology; machines were slow; software took a long time to set up; or the technology in general was not working.
- It was a common belief that there was not enough support from the school in assisting staff in implementing the technology.
- Teachers wanted to continue to investigate ways to better use Microsoft OneNote and DyKnow.

Discussion

The conceptual framework (see Figure 4.28) was used as a lens through which to examine the results in order to answer the research questions.

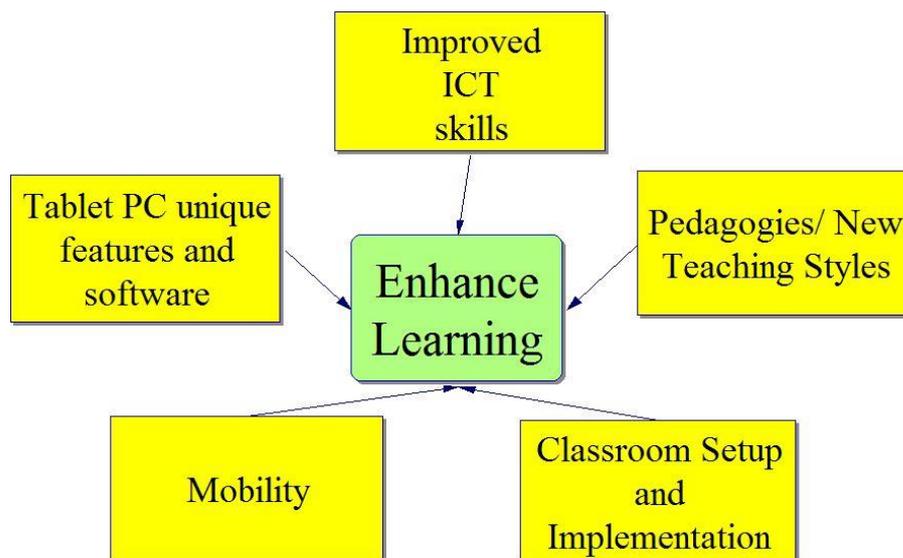


Figure 4.28. Conceptual framework of the study

Each section of the conceptual framework was analysed to see the extent to which the views and thoughts of the school studied aligned with that of the expectations of the study.

Tablet PC unique features and software

All three groups of teachers interviewed agreed that the pen/inking technology, especially the ability to “ink” onto a document, was beneficial. All three gave out and retrieved worksheets that were completed by the students and/or marked by the teacher using the pen technology. Microsoft OneNote was used with varying degrees of complexity, as was DyKnow. This gave teachers the ability to more readily interact with the students. This was also evident in Anderson et al. (2004), who suggested the strength of the software “is the ability to facilitate interactions between students and instructor” (p. 4). There was no indication from the teachers that the Tablet PC was used as a portable classroom, as suggested by Ifenthaler and Schweinbenz (2013) and Kosheleva et al. (2006). Nor was there a suggestion that the Tablet PC in the slate position increased the teacher’s interaction with the students as stated by BECTA (2004).

When the respondents from the teacher questionnaire were asked about the unique features of the software they used with the Tablet PC, they were very vague and general in their responses. The main responses related to Microsoft Office and research; the inking capabilities were very low on the list of answers. When asked about future use of the Tablet PC, DyKnow, Microsoft OneNote and inking were all mentioned.

Improved ICT Skills

While it was not explicitly stated by the teachers who were interviewed that either the teachers’ or the students’ ICT skills improved, it was suggested by some that the use of the Tablet PC and Microsoft OneNote had improved some students’ organisational skills; their ability to use the technology; and in some cases, the students’ stylist handwriting skills. This was also seen in BECTA (2004), Ferrer, Belvis and Pamies (2011) and Twining et al. (2005).

The respondents of the teacher questionnaire indicated their own perceived ICT skills varied greatly but they did not indicate that they believed that the Tablet PC improved either their or their students' ICT skills. However, they did suggest that the Tablet PC made a number of activities easier or simpler, which could imply that they had not perceived that their skills had improved because of the new technology.

Pedagogies/New teaching styles

All three groups interviewed suggested that the Tablet PC was a way of increasing the development of student understanding and learning. This was implemented through the use of DyKnow and Microsoft OneNote, by the way of effortless group work and sharing knowledge, increased independence and organisation as well as frequent and timely formative and summative feedback. This was also evident in Ifenthaler and Scheinbenz (2013) and Kosheleva et al. (2006).

The researcher believes that the majority of the respondents to the teacher questionnaire indicated that they did not really know what or how to use the Tablet PC effectively in the classroom. This was illustrated by the fact that respondents believed that both the students' and teachers' time was not better used when working with the Tablet PC. This is at odds with evidence from other research such as Twining et al. (2005).

New teaching styles were very evident with both the Early Adopters and the Late Adopters. Both groups were willing to try different methods of teaching with the Tablet PC. This was most notable in their use of Microsoft OneNote and DyKnow. These teachers had changed the way in which they taught a lesson because of these types of software. This was also seen in both Cicchino and Mirliss (2004) and Microsoft Corporation (2011b). Whereas, the Reluctant Adopters group did not really change their teaching style, but tried to structure the Tablet PC interaction to fit in with what they had currently been doing. Many of the staff that responded to the teacher questionnaire indicated that they had changed their teaching style due to the Tablet PC being used in the classroom. A large number of them could not articulate exactly how that had occurred.

Classroom setup and implementation

Of the teachers who were interviewed as part of the EoC interview process and the classroom observations, it was evident that the teachers that were more experienced and comfortable with the Tablet PC technology, were more likely to change the actual classroom setup. The teachers with the knowledge and willingness to want to use the Tablet PC technology thought about how to use the technology that was needed and how the room should be set up to maximise the learning of their students. This was evident with the Early Adopters changing the classroom setup when using the Tablet PC. No respondents of the teacher questionnaire raised the topic of how the classroom was setup and implemented; this may be due to the fact that the majority of the teachers used exactly the same set-up in the classroom, whether there was students with computers or not.

Mobility

Mobility of the Tablet PC was not something that was clearly stated by the teachers who were interviewed. It was implied that it was an advantage by the Early Adopters when they were talking about their methods of teaching and how the classroom was setup. This was also evident in Ifenthaler and Schweinbenz (2013) and Newhouse, Williams and Pearson (2006); the Tablet PC improved the ability to work on tasks anytime and anywhere. All three groups suggested the Tablet PC gave both students and teachers the freedom to do what they wanted when they wanted.

It was suggested by very few respondents that mobility was an important factor with regards to the use of the Tablet PC in the classroom. This may have been due to the teachers being used to the students and their laptops and did not see that there was much change in how the Tablet PC was used in the classroom.

Summary of findings

The findings suggest a number of key factors around the use of the Tablet PC in Year 5 to 9 classrooms:

Setup of the classroom

The results of the questionnaire suggested that there was no distinction between how the classroom was setup before and after the implementation of the Tablet PC. This could have been because the questionnaire indicated that the majority of the teachers did not distinguish between a Tablet PC and a traditional Notebook. Whereas the results of the case studies suggested a little more, they stated that the Tablet PC did have an influence on how the classroom was setup.

Implementation of lessons

Both the questionnaire and case studies showed that there was change in the way teachers were implementing their lessons. The questionnaire's results were generalised in how lessons had changed, whereas the case studies described a number of techniques that used the key features of the Tablet PC. Both suggested that the Tablet PC had changed the way the teachers taught their lessons.

Features of Tablet PC being used by teachers

It was clear from both the questionnaire and the case studies that there were a number of features of the Tablet PC that were beneficial to the teachers and students. These features included: pen inking abilities and software like Microsoft OneNote and DyKnow.

Pedagogies being used with Tablet PCs

The case studies provided evidence that the Tablet PC assisted the teachers and students in improving the teaching and learning, especially via the use of the instant feedback features of a couple of Tablet PC software types. However the questionnaires suggested that the teachers perceived that the Tablet PC would not

assist in improving the teaching and learning. This could have been because they did not understand how the Tablet PC could be used to improve learning.

Interaction

There were mixed results with how the Tablet PC in the classroom changed the interaction between the teachers and students. Both the results from the case studies and questionnaire suggested that the teachers did not really know if the Tablet PC had changed the interaction with the teachers and students and if it was for the better. Some teachers suggested that it helped in the students learning while others have indicated that the Tablet PC had increased the isolation of the students.

CHAPTER 5

CONCLUSION

Overview

This chapter reviews the study and summarises the findings in relation to the research question. It discusses the conclusions drawn from the findings, acknowledges the limitations of the study and makes recommendations for further research into Tablet PC technology in schools.

Overview of the study

The objective of this study was to look at ways in which Tablet PC technology was being used in a specific school setting. It looked at how teachers used the Tablet PC in a classroom environment; investigated what unique features of the Tablet PC were being utilised; and what exactly these features were being used for. It looked at how the classroom dynamics changed; the physical look and feel of the classroom; as well as the changes in pedagogies around the use of the Tablet PC. Additionally, the study also investigated the nature of the interaction between teacher/student and student/student, due to the use of the Tablet PC.

Research Findings

This study's research question provided the lens for identifying the key conclusions.

Research Question: What effect on teaching and learning activities did using Tablet PCs have in Year 5 to 9 classrooms?

Overall the findings were inconclusive as to whether the Tablet PC impacted on teaching and learning activities. However in the next section there is discussion of the findings in terms of the themes that have emerged.

Setup of the classroom

In general, the introduction of the Tablet PC into the classroom gave no standardised thought pattern to how the classroom should be set up. There was a vast difference in how each teacher decided to go about their classroom setup, although the teachers who appeared to have more experience/confidence in using the Tablet PC had thought about how they would set the classroom up for optimal learning. These teachers had actually thought about exactly how the tables in the classroom should be situated and where students should be seated to facilitate the best learning possible. For example Jon changed the classroom from the traditional rows facing the front to sets of tables facing each other, at right angles to the front (see *Figure 4.20*).

Implementation of lessons

The research study showed that if the teacher was willing to invest time and effort into setting up appropriate structures and lessons, there was some evidence of improvements in the teaching and learning in the classroom. The issues were that not all teachers had the knowledge or ability to invest the time and effort into setting up the appropriate structures to enable the improved learning. It was evident that there were attempts by many to try to implement lessons in a different way, but for the most part, these were very rudimentary and did not always have the desired result.

Features of the Tablet PC being used by teachers

Features of the Tablet PC involved the use of the pen/inking technology; the way the technology was used was dependent on how involved the teacher was. A significant number of teachers who used the technology, considered that the ability to write and “ink” with the pen should be a huge advantage, especially for students with messy hand writing. Many teachers also acknowledged that the ability to annotate student work electronically was an enormous advantage in being able to get student work marked and returned with feedback in a timely manner. It was also noted that the use of the pen in group and peer work was vital to the success of many tasks around multiple student input at once.

Pedagogies being used with the Tablet PCs

Teachers have moved away from the “chalk and talk” of standing up in front of the classroom and either copying slabs of a textbook onto the whiteboard for students to copy down or getting the students to complete the “left-hand side” of the Mathematics textbook. The introduction of the Tablet PC allowed teachers to deliver more dynamic lessons, using a number of different stimuli to engage the students in learning. One way that this occurred using the Tablet PC was via the use of Microsoft OneNote and setting up whole syllabuses in electronic workbooks so that students could access coursework and complete the required tasks effortlessly. Teachers were then able to see a complete overview of how each student was progressing via the students’ Microsoft OneNote file. This allowed for instant feedback on each

student's progress, something that had not been completed before without maximum effort and resources.

Interaction between students and teachers

There was evidence that the interaction between students and teachers varied from teacher to teacher. Some teachers indicated that the technology allowed for a greater interaction and there was far more classroom discussion as a result. Others believed that the Tablet PC increased the isolation of the students; students would now spend more time on the Tablet PC doing their work. While the research leaned towards there being an increase in interaction between the students and the teacher, there was no clear indication that this had a positive effect on the learning of the students.

Interaction between students and students

There were very similar findings in relation to the influence of the Tablet PC on the interaction between students. A number of staff indicated that students seemed to be more involved in group and peer discussion (direct observations supported this), whereas others believed that the Tablet PC again increased student isolation. There was no clear indication as to whether the Tablet PC increased or decreased interaction between the students.

General Findings

The researcher observed on a number of occasions, each of the teachers that was involved in the EOC interviews and these direct observations indicated that the students used the Tablet PC's pen and inking capabilities far more than was stated by the teachers in both the questionnaire and interviews. Students were observed using the pen and inking capabilities more often than not, although it does need to be noted that many students used the pen and inking technology while the Tablet PC was still in the traditional clamshell position.

As a result of the study, it was evident that, Tablet PC technology should not necessarily be used all the time, as recommended by the school, but used only when

the teacher thinks it is most appropriate and it is going to get the best out of the students. There were feelings from a number of staff members that this new technology was being “forced down their throats” (Interview with Jon) without any real evidence to show that it worked.

A number of teachers suggested that key features of DyKnow and similar programs benefited the learning of students or enhanced their learning experience. A number of these features were not unique to the Tablet PC and could have been used with a conventional Notebook, but the benefit of using these features seemed to be enhanced when used in conjunction with the features of a Tablet PC, for example, the ability to collaborate via DyKnow or Microsoft OneNote; using the “inking” capabilities; and students “inking” onto a shared DyKnow worksheet.

At a point during the research, all but a few teachers had stopped using DyKnow as they felt that the time spent setting up and using the software with the students was time consuming and, while they agreed there were learning benefits, the time wasted, outweighed the benefits. Learning could be done easily another way. Teachers instead moved to the use of Microsoft OneNote in which whole syllabuses could be created in one file, where both teachers and students could easily monitor their own progress through the syncing of files via the school’s network.

The overwhelming factor that needs to be stated as determining the success of the implementation of the Tablet PC to assist the teaching and learning in the classroom was that of experience and level of knowledge. It was clear that if teachers had knowledge of how to use the technology then they were willing to try to work with the technology and found that there were benefits for both the teacher and students. It is possible that there were too many stumbling blocks to actually try to use the Tablet PC in the classroom. For example, students did not always bring their Tablet PC to class; the infrastructure was not suitable; or software took too long to load and/or did not always work.

Implications

The proposed implementation of the Australian Curriculum for Technologies (Australian Curriculum, Assessment and Reporting Authority (ACARA), 2013) (In draft form at time of writing) has a focus on the use of Information Communications Technologies (ICT) from foundation to Year 10. The use of the Tablet PC in the classroom is likely to assist in the successful implementation. ACARA recommends that ICT is to be implemented across all year levels from Prep to Year 10.

The findings of this study are significant because it is important that the school in question is clear on exactly how they are going to implement ICT across all curriculum areas. It is clear from this study that the implementation of the Tablet PC into the school needed to be accomplished better. There were a number of key indicators that needed to improve if any implementation was going to be successful.

- An increase in the Professional Development for teachers in the use of the Tablet PC in the classroom
- An increase in the time allocated for teachers to investigate and create learning activities
- Improvements in the infrastructure so that the technology works all the time
- Improvement in the quality of the student Tablet PCs
- More emphasis on the students bringing their Tablet PCs to the classroom across the whole school

Limitations of the Study

This thesis did not discover findings that could be generalised to a wider population, instead it sought to look at a single school within particular classrooms. The findings are specific to this research site. An additional limitation was that the sample selection was not random. Different samples may have achieved different results. Only a limited number of teachers returned questionnaires, which resulted in not getting a broad range of responses. The results may have been more useful if a greater proportion of the staff had completed the questionnaire. Not enough teachers were interviewed using the EoC interview method so a broader perspective

could have been obtained. As a result of the limited numbers, a detailed analysis of the use of the Tablet PC in the classroom was not conducted.

Recommendations for future research

There was enough evidence to suggest that, with more time, effort and planning, the Tablet PC has an important place in the development and implementation of lessons. Not enough staff actually knew what the technology was capable of doing. If there was more time allocated to Professional Development of staff and training for students, then far more educational benefits could be realised. Both Borthwick and Pierson (2008) and Burns (2010), agreed that Professional Development of teachers in the use of ICT is recommended, if the technology is going to be used successfully in the classroom.

The study needs to be replicated but involving a greater proportion of staff within a school setting. This larger quantity of data may more clearly show whether using the Tablet PC does improve the teaching and learning of students.

With the introduction of Windows 8 and slate devices, the future of Tablet PCs in the classroom is looking promising. The machines are getting lighter and costing less, which allows for a far greater scope in what can be done with the Tablet PC in a learning environment. For example, the lighter Tablet PC means better mobility and that it could easily be used on the sporting fields as part of a Physical Education class or in conjunction with science students and their experiments. With the machines costing less, it gives schools the ability to purchase more machines. The technology will not just be located in the classroom but everywhere at any time.

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APPENDICIES

Appendix A: Experience of Change (EoC) Instrument	111
Appendix B: Teacher Questionnaire	114
Appendix C: Staff member interview consent form	120
Appendix D: Sample PowerPoint Presentation from students in one of Barry's lessons.....	121
Appendix E: Formative Assessment and Mini Whiteboards.....	123

Appendix A: Experience of Change (EoC) Instrument

- **Twenty-four feelings cards**

committed	enthusiastic	exhilarated	optimistic
confident	stimulated	supported	valued
comfortable	pleased	interested	satisfied
worried	confused	disappointed	irritated
anxious	bored	cynical	sad
angry	frustrated	isolated	pressurised

- **The board**

How do you feel.....

Make each question in a piece of paper, pile them together, and open each one e.g.

Administration

Thinking about how you feel ***about your and the school's use of the Tablet PC in the classroom.*** Place each of the cards in the place that you think it belongs.

A Often	B Sometimes
C hardly ever	D Doesn't seem relevant

(Ainscow, Hargreaves, Hopkins, Balshaw & Black-Hawkins, 1994 p.19)

- **Instruction sheet**

Stage 1: Lay out the board and explain purpose

Place board in front of interviewee and stack of cards
 [Note: Always with 'pleased' or 'comfortable' on top].
 Explain that the results will be reported anonymously.
 This is about your personal feelings.
 Purpose: To understand how you feel about your and the school's use of the Tablet PC in the classroom.

Stage 2: Interviewee places cards, one at a time, into piles on the board

There are 24 word cards and two blank cards at the bottom upon which you can add words.
 Take a card in turn and place it in the pile where you feel it belongs. Did you feel this OFTEN, SOMETIMES, HARDLY EVER or perhaps the feeling DOESN'T SEEM RELEVANT. No need to spend very long on each card. We'll total them when you have finished.

Stage 3: Interviewee tells story using OFTEN cards (record this!)

Take the cards from the OFTEN pile and use them to tell your story.
 How is your feeling by the cards?
 Remember that information from this will only be reported anonymously.

Stage 4: Afterwards - explain scoring (but score later)

Explain that scoring will be done later but that each card is worth one of four scores (++, +, -, --) and in one scoring scheme, points are allocated for cards in the OFTEN bucket.

Overall impact

NOTE: Refer to instructions page, use board and cards.

MINIMUM SCORING MODEL: Record the OFTEN cards with a tick

++		+		-		--	
Committed		Comfortable		Worried		Anxious	
Enthusiastic		Pleased		Confused		Bored	
Exhilarated		Interested		Disappointed		Cynical	
Optimistic		Satisfied		Irritated		Sad	
Confident						Angry	
Stimulated						Frustrated	
Supported						Isolated	
Valued						Pressurised	
TOTAL		TOTAL		TOTAL		TOTAL	

Score					
	X+2	X+1	x1	x2	Final score: /20

Add a comment about the person's reaction, your feelings etc.

Did they seem optimistic overall?

Did they overreact to something?

Are they likely to change score easily?

- **Aggregate Profile Matrix**

	Feeling	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Free Count
++	Committed																
	Enthusiastic																
	Exhilarated																
	Optimistic																
	Confident																
	Stimulated																
	Supported																
	Valued																
+	Comfortable																
	Pleased																
	Interested																
	Satisfied																
-	Worried																
	Confused																
	Disappointed																
	Irritated																
--	Anxious																
	Bored																
	Cynical																
	Sad																
	Angry																
	Frustrated																
	Isolated																
	Pressurised																
Profile	Profile																
	Key/++/+/-/- -(in A)																
	Extra words score																

Code: A: Often / **B:** Sometimes / **C:** Hardly ever / **D:** Doesn't seem relevant (wastebin)

Respondents in randomised order



Teacher Questionnaire

Information Sheet

The included questionnaire is being used to survey a sample of teachers from [REDACTED]. This forms part of a Masters Research project being conducted by Andrew Stewart.

This is an anonymous questionnaire. By completing the questionnaire you are consenting to take part in this research, so you should first read the following Disclosure Statement carefully as it explains what this research is about.

Disclosure Statement

The intention of this study is to look at ways in which the Tablet PC technology is currently being used at [REDACTED]; to look at how teachers use the Tablet PC in a classroom environment; to investigate which unique features of the Tablet PC are being utilised and what exactly these features are being used for. It will look at how the classroom dynamics are affected; the physical look and feel of the classroom as well as the changes in pedagogies around the use of the Tablet PC. The study will also look at how the interaction between student/teacher and student/student has changed, due to the use of the Tablet PC.

Andrew Stewart is surveying all teachers at [REDACTED] to collect data on current perceptions, activities and concerns with respect to a number of areas of interest in the project.

Your responses will be strictly confidential, only Andrew Stewart and his supervisor will see your particular responses. The information will be collated with no reference to individuals and no identifying information. The Master's project will only include general and summary information and will in no manner identify individual or groups of teachers.

Instructions to Teachers

We would be grateful if you would spend 20 minutes filling in the survey form included with this letter. Some items require you to tick an alternative while others provide the opportunity for you to write brief responses (note form is desirable).

To ensure maximum confidentiality, a sealable envelope has been included. When you have completed the questionnaire, please place it in the envelope marked 'Tablet PC Teacher Questionnaire, Edith Cowan University' and **return it to the Deputy Principal Office (Senior Campus), [REDACTED] (Junior Campus)**, who will then return it to the appropriate person. Can this questionnaire please be filled out and returned no later than Friday 8th October.

We would like to thank you in advance for your assistance. If you have any concerns or complaints about the research project and wish to talk to an independent person, you may contact:

Research Ethics Officer
Edith Cowan University
270 Joondalup Drive
JOONDALUP WA 6027
Phone: (08) 6304 2170
Email: research.ethics@ecu.edu.au

This project has been approved by the Human Research Ethics Committee at Edith Cowan University.

Teacher Questionnaire

This is an anonymous questionnaire. By completing the questionnaire you are consenting to take part in this research. You should first read the included Disclosure Statement that explains the intentions.

Gender (circle): **M / F** School: _____

Years of teaching experience: ____ **yrs** Years at present school: ____ **yrs**

Describe your current role(s) at the school: eg, subject areas, roles of responsibility.

(a) _____ (b) _____ (c) _____

Average number of Tablet PCs available to you in your classrooms: _____

FOR QUESTIONS 1 to 5 CIRCLE one alternative or TICK a cell for each item

1. (a) For how many years have you been REGULARLY using Tablet PCs at school with students (averaging at least once a week)?

Never 1 or 2 years 3 or 4 years 5 or more years

- (b) For how many years have you been REGULARLY using Tablet PCs for work-related tasks?

Never 1 or 2 years 3 or 4 years 5 or more years

- (c) How often did you facilitate the use of Tablet PCs by your students last TERM?

Daily Weekly Fortnightly Occasionally Never

- (d) How often would you like to see students using Tablet PCs in your classes?

Daily Weekly Fortnightly Occasionally Never

2. Indicate how often over the past YEAR you used each of the following strategies.

Each Each On
Week Fortnight occasions Never

- (a) Each student uses a computer in a laboratory
- (b) Each student uses a Tablet PC in the classroom..
- (c) Students work in pairs with Tablet PCs.....
- (d) Students work in groups with Tablet PCs.....
- (f) Students use Tablet PCs outside class time.....

	Each Week	Each Fortnight	On occasions	Never
(a)				
(b)				
(c)				
(d)				
(f)				

3. Indicate how often over the past YEAR your students used Tablet PCs for each of the following purposes.

Each Each On
Week Fortnight Occasions Never

Tablet PCs are used by my students to ...

- (a) illustrate a concept
- (b) type assignments (e.g. word processing)
- (c) access information
- (d) analyse information (e.g. statistics, graphs)
- (e) present information (e.g. publishing, slideshows) ..
- (f) store information
- (g) simulate an environment or action
- (h) make a product
- (i) develop a skill (e.g. typing, tables)
- (j) provide a problem
- (k) other (specify)

	Each Week	Each Fortnight	On Occasions	Never
(a)				
(b)				
(c)				
(d)				
(e)				
(f)				
(g)				
(h)				
(i)				
(j)				
(k)				

4. How do you feel when you support students in using Tablet PCs? (Circle one or more)

anxious isolated worried comfortable confident excited

5. When students use Tablet PCs in your class how often are the following outcomes evident.

- (a) Better understanding of curriculum content.
- (b) Students think in different and interesting ways.
- (c) Students learn more quickly.
- (d) Students help each other.
- (e) The teacher's time is better used.
- (f) Students complete more work.
- (g) Students enjoy learning.

	Each Week	Each Fortnight	On Occasions	Never

FOR QUESTIONS 6 to 10 provide BRIEF written responses for each item (note form is fine)

- 6. (a) During this YEAR or so, for what learning activities have your students used Tablet PCs?
 - (b) What added value do you expect for your students by using Tablet PCs?
 - (c) How do you decide when to use Tablet PCs to support student learning?
 - (d) What do you consider the most effective uses of your Table PC in the classroom?
 - (e) With your students what would you like to use Tablet PCs for that you do not do at present?
 - (f) Which classroom tasks were simpler or easier when using your Tablet PC?
 - (g) What things prevent you from effectively using Tablet PCs with students?
7. To what extent does the work students complete using Tablet PCs contribute to assessment?
8. Have your students used online resources over the last TERM? **YES / NO** If YES, explain how.
9. (a) Are you making any changes to your teaching style due to you having a Tablet PC? **YES / NO**
If YES, explain what.
- (b) Are you making any changes to your teaching style due to you and your students having a Tablet PC? **YES / NO**
If YES, explain what.
10. Do you contribute to Tablet PC-related planning? **YES / NO** If YES, explain how.

FOR QUESTIONS 11 and 12 tick ONLY ONE CELL for each row. If you have more than one class, answer in terms of the class that uses computers most often.

11. Select the description that BEST fits your use of learning technologies.	I like to direct student activities and choose learning resources.	I have begun to experiment with activities based on student choice.	I like to give students in my class the opportunity to facilitate their own problem-solving activities.	I like to give all the students in my class full ownership of learning, constructing meaning and solving problems.
12. Select the description that BEST fits your present situation.	I am aware that information technology can be used to support student learning but have not used it.	I am beginning to understand the process of using computers and can think of tasks in which it might be useful. I am trying to learn the basics but am often frustrated.	I am gaining a sense of confidence in using the computer for specific tasks. I am starting to feel comfortable using the computer.	I am not concerned about computer technology. I can use it in many applications and am able to facilitate its use as a learning tool and integrate it into the curriculum.

13. Subject-related strategies – for each of the following, how often did you use a Tablet PC during a class or in a course-related activity (planning, grading, etc.)?

Please CIRCLE: 4 = every day, 3 = once a week, 2 = sometimes, 1 = one time, 0 = never

- | | | | | | |
|---|---|---|---|---|--|
| 4 | 3 | 2 | 1 | 0 | 1. Assignment mark-up – adding comments “on top of” student work, using <i>Word</i> , <i>Onenote</i> or <i>Journal</i> |
| 4 | 3 | 2 | 1 | 0 | 2. Live annotation – adding notes to an in-class presentation, e.g. with <i>PowerPoint</i> |
| 4 | 3 | 2 | 1 | 0 | 3. Fill-out forms – checking boxes or filling in blanks on a document in <i>Word</i> , <i>Onenote</i> or <i>Journal</i> |
| 4 | 3 | 2 | 1 | 0 | 4. Note-taking – during a class |
| 4 | 3 | 2 | 1 | 0 | 5. Drawing – illustrating a concept or topic, using drawing software or <i>PowerPoint</i> tools |
| 4 | 3 | 2 | 1 | 0 | 6. Multimedia library – storing images, music, or text on the Tablet for use in class |
| 4 | 3 | 2 | 1 | 0 | 7. Wireless presentation – projecting the Tablet screen while walking around the classroom |
| 4 | 3 | 2 | 1 | 0 | 8. Student files – saving student work for grading or later |
| 4 | 3 | 2 | 1 | 0 | 9. Responding to students’ questions via the Tablet PC – either via a data projector or on your own screen |
| 4 | 3 | 2 | 1 | 0 | 10. Data collection – recording scientific data or student observations “live” |
| 4 | 3 | 2 | 1 | 0 | 11. Email – sending feedback to students during class |
| 4 | 3 | 2 | 1 | 0 | 12. Live assessment collection – obtaining student assessment as you go in the classroom eg Dyknow classes |
| 4 | 3 | 2 | 1 | 0 | 13. Other – |
| 4 | 3 | 2 | 1 | 0 | 14. Other – |
| 4 | 3 | 2 | 1 | 0 | 15. Other – |

14. Software – how often did you use the following software on your Tablet PC during a class or in course-related activities?

Please CIRCLE: 4 = every day, 3 = once a week, 2 = sometimes, 1 = one time, 0 = never

- | | | | | | |
|---|---|---|---|---|---|
| 4 | 3 | 2 | 1 | 0 | 16. <i>Windows Journal</i> (Microsoft) |
| 4 | 3 | 2 | 1 | 0 | 17. <i>OneNote</i> (Microsoft) |
| 4 | 3 | 2 | 1 | 0 | 18. <i>PowerPoint</i> (Microsoft) |
| 4 | 3 | 2 | 1 | 0 | 19. <i>Word</i> (Microsoft) |
| 4 | 3 | 2 | 1 | 0 | 20. <i>Excel</i> (Microsoft) |
| 4 | 3 | 2 | 1 | 0 | 21. Internet Explorer (Microsoft) or equivalent |
| 4 | 3 | 2 | 1 | 0 | 22. <i>Dyknow</i> |
| 4 | 3 | 2 | 1 | 0 | 23. <i>Acrobat</i> (Adobe) |
| 4 | 3 | 2 | 1 | 0 | 24. <i>Snipping tool</i> |
| 4 | 3 | 2 | 1 | 0 | 25. <i>iTunes</i> (Apple) |
| 4 | 3 | 2 | 1 | 0 | 26. Other – |
| 4 | 3 | 2 | 1 | 0 | 27. Other – |
| 4 | 3 | 2 | 1 | 0 | 28. Other – |
| 4 | 3 | 2 | 1 | 0 | 29. Other – |
| 4 | 3 | 2 | 1 | 0 | 30. Other |

15. Rate yourself on your skill level in using the following Tablet PC applications and equipment.
For each row TICK THE CELL that best describes your skills.

Word processor	can't do much	can print a document, change fonts, spell check, insert footer and page numbers.	can insert images, create tables, change Page Setup, change margins.	can use columns and sections, set up styles, use mail merge.
Spreadsheets	can't do much	can enter data and calculations, format cells, use Sort, insert and delete rows and columns, create and modify charts [graphs].	can use complex formulae, use absolute and relative cell references, use multiple worksheets.	can use filtering, can use conditional formatting, can import data.
Databases	can't do much	can create simple tables, use simple queries to retrieve data, use wizards to create reports and forms.	can use relational databases, use wizards to create forms, sub-forms or portals, use more complex form design tools.	can create and use parameter queries, create summary reports, use complex functions in queries.
Slideshow software	can't do much	can create a slide show, insert images, change font and layout.	can navigate during a presentation, add animation, transitions, and hyperlinks.	can create a master slide, include sound, print handouts, add navigation buttons.
Email	can't do much	can create, (comma) send and access emails, can add to and access Address Book entries.	can store messages in folders, locate Sent and Deleted messages, add a Signature, can add attachments.	can create a mailing list, set up a discussion list.
Computer File Management	can't do much	can save files in a folder, create and name folders, can navigate between folders, copy, delete and rename files.	can recognise file types, navigate between drives, directories, and into a network, use Help files, install software.	can zip and unzip files, do complex searches for files, create short-cuts, use control panels to connect to networks.
The Internet	can't do much	can navigate to known web sites, can create Favourites, do basic searches.	can use advanced searches, organise Favourites, alter browser preferences, save images and text.	can conduct complex searches, download and install software and plugins, use different browsers.
Web page authoring	can't do much	can create pages and links, insert and format text, insert images, use tables, create external links.	can create a site using naming conventions and folder structure, insert sound, upload files to the web, use alt text.	can build a complex site, insert components such as JavaScript.
Digital photography	can't do much	can take and delete pictures in-camera and transfer images to a computer.	can review images on camera, adjust camera settings such as flash and close-up.	can adjust camera menu options such as resolution and shutter speed.
Image editing	can't do much	can edit images including crop, scale, rotate and delete.	on computer can change file size, resolution and format (eg jpeg, png) as appropriate to purpose.	can undertake complex image manipulation using special effects.
Video photography and editing	can't do much	can adjust camera settings (zoom and replay), transfer files to computer, assemble with minimal editing.	can use basic software to introduce transitions, import and edit sound track, add titles and subtitles.	can use advanced software to apply complex editing and special effects.

You have finished! Thank you for your important contribution.

Appendix C: Staff member interview consent form

☎: 0353308272
email: astewar4@our.ecu.edu.au



Staff member interview consent form

Project Title: A study on how the Tablet PC can enhance the learning environment within a classroom

I am seeking your participation in a study on how the Tablet PC can enhance the learning environment within a classroom. As a teacher with a Tablet PC, I am asking if you would like to be involved in this study. The intention of this study is to look at ways in which the Tablet PC technology is currently being used [REDACTED]; to look at how teachers use the Tablet PC in a classroom environment; to investigate what unique features of the Tablet PC are being utilised and what exactly these features are being used for. There is no obligation for any teacher to enter into the study and no adverse consequences will arise from not taking part.

If you agree to participate in this study, I ask you to please fill in the attached consent form below and I will conduct a 20 - 30 minute interview with you. As well as the interview I may want to video record a number of your lessons.

If you have any questions or require any further information about the research project, please contact Andrew Stewart on 0353308200 or Jeremy Pagram (supervisor) on 08 93706331.

If you have any concerns or complaints about the research project and wish to talk to an independent person, you may contact:

Research Ethics Officer, Edith Cowan University 270 Joondalup Drive JOONDALUP WA 6027 Phone: (08) 6304 2170 Email: research.ethics@ecu.edu.au

If you are happy to participate, I request that you sign and return the consent form to me at the bottom of this document.

Yours sincerely

Andrew Stewart

CONSENT FORM

Research Study: **A study on how the Tablet PC can enhance the learning environment within a classroom**

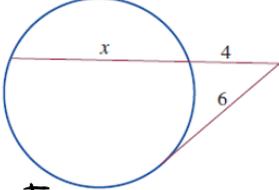
I _____ have read the information and been informed about all aspects of the above research project. I am happy to participate in the research project as requested by the researcher. I understand that I may withdraw from the project at any time.

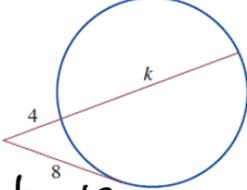
I agree that the research data gathered for this study concerning my activities can be published provided I am not identifiable in any of the reports that are produced.

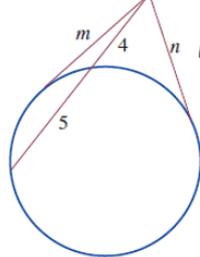
Signed _____

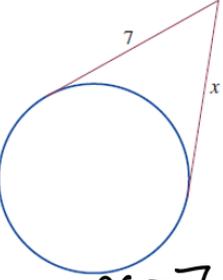
Date _____

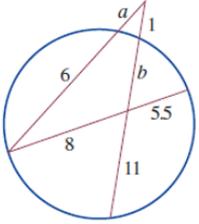
For each of the following, find the value of the pronumeral and state which circle theorem you used to help determine the pronumeral

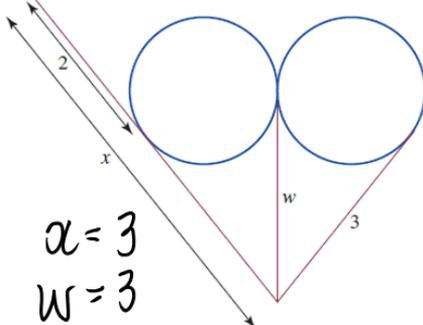
a  $x = 5$

b  $k = 12$

c  $m = 6$
 $n = 6$

d  $x = 7$

e  $a = 1$
 $b = 5.5$

f  $x = 3$
 $w = 3$

Key Terms

- List some of the key terms that you think are an important part of being able to understand and solve problems involving circle theorems

Secant Perpendicular
Tangent Corresponding
Chords Alternate
Arc Congruent

Question 5

The temperature of an endothermic reaction is monitored during a chemistry experiment

1. Find a rule to model the function
2. Sketch the graph
3. What was the starting temperature?
4. What is the temperature going to be after 10 minutes?
5. What will the temperature be after 94 minutes? Is this reasonable?
6. How long has the reaction been going if the temperature reaches -23 degrees?

Time (mins)	Temp (Celsius)
1	1
2	-2
3	-5
4	-8
5	-11

1. $y = -3x + 4$

2.  $6. y = 3(23) + 4$

3. 4°C

4. $y = 3(10) + 4$

5. $y = 3(94) + 4$

Appendix E: Formative Assessment and Mini Whiteboards

Quite in the contrast is the use of “formative evaluation” to provide feedback and correctives at each stage in the teaching-learning process. By formative evaluation we mean evaluation by brief tests used by teachers and students as aids in the learning process. While such tests may be graded and used as part of the judging and classification function of evaluation, we see much more effective use of formative evaluation if it is separated from the grading process and used primarily as an aid to teaching. Bloom (cited in William, 2011, p. 33)

Formative assessment is defined by Black and William (cited in William, 2011, p. 37) as “encompassing all those activities undertaken by teachers, and/or by their students, which provide information to be used as feedback to modify the teaching and learning activities in which they are engaged”.

Formative assessment is widely used at the school across all subjects. There are a number of different strategies that have proven to be very valuable and highly successful in assisting teachers to gauge where students are, at a point in time. One of these strategies used at the school is the Mini Whiteboards.

The Mini Whiteboards are exactly what they sound like, a small piece of white board that each student has with them in the classroom, accompanied by a whiteboard marker and eraser. A teacher can quickly frame a question and get an answer from the whole class with ease. The teacher can instantly know what students in the class understood the concept they were learning.