Introducing pocket PCs in schools: Attitudes and beliefs in the first year

Wan Ng*, Howard Nicholas
Faculty of Education (Bundoora), La Trobe University, Kingsbury Road, Bundoora, Victoria 3086, Australia

ARTICLE INFO
Article history:
Received 23 May 2008
Received in revised form 2 October 2008
Accepted 4 October 2008

Keywords:
Implementing pocket PCs in curriculum
Attitudes
Beliefs
Primary school education
Secondary school education

ABSTRACT
As more schools adopt the use of handheld computers in their classrooms, research that systematically tracks their introduction is essential in order to develop a model for successful implementation leading to improved classroom teaching. This research report seeks to explore the realities of introducing and integrating handheld computers into five Victorian schools in Australia where the initiative is owned and funded by the schools themselves. The research focused on how teachers' attitudes and beliefs evolved over about 6–7 months of implementing the pocket PCs in their teaching. The findings indicated that the effect of pocket PCs on the attitudes of primary teachers were mixed while that on the secondary teachers was uncertainty. However, both primary and secondary teachers shared similar beliefs in the motivational aspect of the technology on student engagement and its capacity to cater for weaker students, particularly in English, but not for the more academic students. Issues such as leadership roles, the time-consuming nature of lesson preparation, the need to integrate higher-order thinking tasks with pocket PC usage and personal ownership for successful integration of the technology are discussed.

1. Introduction

Handheld computing includes PDAs, smartphones, the iPhone, ultramobile computers, MP3 players or mobile games consoles. Each offers different combinations of affordances such as personalised and portable access to the Internet and context sensitive interactivity. These affordances have been described by Kimber and Wyatt-Smith (2006), Perry (2003, 2006), Sharples (2003) and Waycott, Jones, and Scanlon (2005) as contributing to ubiquitous computing and seamless learning, where making use of the technology neither interrupts nor distracts from the processes of interaction and learning. Weiser (1991) views ubiquitous computing as ‘calm technology’ where the technology moves seamlessly and effortlessly between the learners’ periphery and centre of attention. O’Malley and Fraser (2006) describe technology associated with ubiquitous computing as so embedded in the world that it ‘disappears’. On this basis, a ubiquitous computing approach sees handheld computing transforming educational practices in much the same way as in previous centuries the pen transformed fundamentally oral teaching practices – freeing the students from dependence on the teacher for access to information and enabling the student to take the technology with them outside the classroom (Perry, 2003).

This exploratory research documents the introduction of wireless PDAs in five Victorian schools (three primary, two secondary) in Australia over approximately one year (April 2006 to February 2007) from inception to integration into the schools’ curriculum programs. The schools, who referred to the PDAs as pocket PCs, were interested in a ubiquitous tool for use in the classroom and in the field to bring about improved learning in students. The philosophy underpinning the introduction of the pocket PC program into the cluster of schools reflected generational changes in pedagogy. The teachers referred to the primary and secondary students in this cluster of schools as the m-generation, with ‘m’ meaning both ‘mobile’ and ‘multimedia’. The students were characterized in the following way by a member of the school staff and as presenting the associated technical and pedagogical challenges:

we don’t want text-based (materials) because that bores generation-m. They want multimedia and graphics. ... it’s a bit like a duck to water for them – it’s (pocket PC) just a slightly bigger version of an iPod or a memory stick or a digital camera. They’re not scared of playing with them.

(Primary IT support staff, preliminary interview)
The schools' enthusiasm for pocket PCs and interest in research was articulated by one of the principals in the initial planning stages of the program that "all schools are excited by what we have seen (in visits to UK, US and Singapore) so far and are keen to produce research that is of benefit to the schools, to the university for the next part of the research (in relation to a grant application), to the companies – Microsoft and DELL, and eventually to DE&T (state education authority) – and maybe even worldwide!". As the researchers had a relationship with the schools from previous project work, they were approached to conduct the research.

The broad research question for the study was: What are the effects of pocket PCs on the attitudes and beliefs of teachers during their introduction into schools?

Underpinning this research question are the following:

1. How did the five schools implement pocket PCs in their classrooms?
2. How did the teachers integrate the use of pocket PCs in the curriculum area[s] that they were teaching?
3. What did the students think about using pocket PCs in their learning?
4. What were the changes in attitudes and beliefs of the teachers about pocket PCs in their teaching about a year later?

In this study, attitudes are the constructs (emotions) that represent whether participants view pocket PCs positively, negatively or in neutral terms. Beliefs are the ideas and thinking behind how they conceptualise the role of pocket PCs in teaching and learning. A teacher could have very positive attitudes toward the introduction of pocket PCs in his/her class and strong beliefs that these devices will make a big impact on the learning outcomes of students. Over time, the attitudes could remain positive but beliefs about impact may be re-articulated in terms of the factors that influence impact.

2. Integrating handheld technology into classrooms

The pocket PCs in this study are not as powerful as laptops but the technology is evolving quickly as more software applications are produced and more hardware features are integrated. For the moment, the affordability of the devices means that the technology is within the reach of students who could not afford other forms of computing. In schools, the availability of handhelds could reduce pressure on computer laboratories or queuing to get access to other reference and learning materials. In wireless-equipped handhelds, the technology enables access to information on the Web anytime while additional reference materials such as e-books, encyclopaedia, simulations and worksheets can be installed in the handhelds allowing for independent learning. These capabilities are, however, not without their issues. For example, the smaller screen size of the pocket PCs does not display all parts of webpages and there is a need to scroll to view the page, adding further cognitive load (Nicholas & Ng, 2008).

Further issues with integrating handheld devices have been identified in other studies. Perry (2006) stated that the requirement to plan for and purchase additional technology such as wireless access points means that handheld computers are not yet an 'off the shelf product' for education. In addition, the pedagogy associated with the technology also requires substantial change from current approaches to education since “a world in which children own powerful multimedia communicators and where they practise new skills of online file sharing and informal text communication does not fit easily with traditional classroom schooling” (Sharples, Taylor, & Vavoula, 2006, p. 21). The time-consuming and challenging nature of introducing handhelds and mobile devices into classrooms has been reported by McFarlane, Triggs and Yee (2008) for PDAs and Twining, Evans and others (2005) for tablet PCs.

Frameworks and approaches for the implementation and integration of technology, including mobile technologies, in schools have been reported (Gulbahar, 2007; Motiwalla, 2007; Sharples, 2000). There are, however, few papers that systematically track classroom adoption of handheld computers from their inception to their implementation. Publications are usually supported by funded projects, for example, the Palm Education Pioneers Program (Valhey & Crawford, 2002) and Becta’s ICT research on pocket PC computers in schools (Perry, 2003; McFarlane, Triggs & Yee, 2008; Twining, Evans and others, 2005). Reports from funded research projects have indicated the high motivational and engagement levels of students learning with these devices and the potential of using them for improved learning outcomes. In Australia, the uptake of handheld computers in schools has been slow. Unlike in the US and UK, there is an acute lack of research in this area. This study explores the realities of introducing and integrating wireless pocket PCs into five schools in Australia, where the initiative was owned and funded by the schools themselves.

3. Methods of data gathering and analysis

The three primary and two secondary schools that participated in this study were located in the northern and eastern regions of Melbourne, Australia. Four of these schools were in low socio-economic regions.

The class sets of 20–30 pocket PCs purchased were Dell Axim X51 (520 MHz), using the Microsoft Windows platform. These devices were equipped with WiFi and Bluetooth functions, had voice recording capability, but did not contain either cameras or video recording capacity.

The research made use of qualitative methodologies of data collection and analysis. Interviews and observations were methods employed to study if attitudes and beliefs of teachers altered over the first year of the introduction of the pocket PCs into their schools. The analysis of the data gathered was underpinned by the theory that instructional beliefs shape the integration of technology (Handal, 2004). We sought evidence of teacher attitudes and beliefs and how they related to the experiences with the Pocket PCs of both teachers and students in order to see whether the attitudes and beliefs related to the same phenomena and what the direction of relationship was between the attitudes/beliefs on the one hand and experiences on the other.

Data were collected as follows:

3.1. Focus group interviews at two stages of the research

The first structured interview was conducted with all the teachers who were becoming involved in the pocket PC program from the five schools. The interview was conducted at the beginning of term 3 (June 2006) of the Victorian school year, which is made up of four school
terms (see Table 1). The first two school terms were when the pocket PCs had arrived and the participating teachers in four of the schools (except SecSch1) had been provided with a personal pocket PC for familiarization purposes. Some of the teachers had limited professional training on the use of the pocket PCs from the IT support staff, who also created mini ‘ebytes’ – short multimedia animations that introduced and reinforced the tools available in the pocket PCs in a fun and innovative way. The ebytes usually contained some introductory material followed by instructions for a task or a problem for use in the pocket PCs. By the time of the first focus group interview, most of the participating staff had started introducing pocket PCs into their classes.

The first interview was video taped with the 12 participating teachers and other support staff from the schools. The interview lasted about an hour, was semi-structured and focused on (a) what it was like to have the pocket PCs in the classroom for the first time (b) how access to pocket PCs changed the teachers’ thinking and (c) what was possible in the teachers’ future classroom that did not seem possible before pocket PCs. The interview questions are in the Appendix.

The second focus group interviews were conducted in mid-December 2006 with participating teachers from PrimSch1, PrimSch3 and the two secondary schools. The remaining primary school teachers were unavailable in December and the interview was conducted toward the end of February 2007 after the summer vacation. The questions focused on (a) highlights and challenges encountered in the use of pocket PCs, (b) what the teachers considered as rich pedagogy, (c) how their thinking and teaching had changed and (d) possible ways forward. The second focus group interview questions are also in the Appendix.

The interview data were transcribed and analysed for similarities and differences in changes (or no changes) in attitudes toward use of pocket PCs between the teachers from the primary and secondary schools at each of the two interview time. Themes for beliefs were analysed in terms of the highlights, challenges and impact of the pocket PCs on students and on their own teaching.

3.2. Observations of classes

In between the interviews, observations were made in classes where pocket PCs were used. It was difficult to arrange for class observations with all of the teachers when requested by the researchers. However, with most of the teachers, observations of at least one class per teacher per school were made shortly after the first interview was conducted and also about 4–5 months later. The interviews took place mostly in June/July 2006 and November 2006. Field notes were taken during class observations, noting:

- The tasks associated with the use of the pocket PCs
- How teachers provided instructions for the tasks
- The engagement levels of the students and
- The level of difficulty of the tasks

Informal interviews were also conducted with the students and teachers. The observation data were analysed for similarities and differences between the five schools. Observation data were triangulated with the interview data.

3.3. Focus group interviews with students

Semi-structured focus group interviews were conducted with students from the pocket PC classes of the schools to elicit attitudes of the students after about six months of using the devices. The student questions were centred around (a) what they used the pocket PCs for, (b) what the best and worst things about using pocket PCs were, (c) whether they liked using them and (c) what they learned with the pocket PCs. The students’ data were used to complement and help interpret changes in the attitudes and beliefs of teachers.

Studying the similarities and differences between five different schools constitutes another form of triangulation as it provided the opportunity to compare data across different contexts.

The normal process of applying for ethics approval and obtaining consent from the university and the state education authority was followed in this research study.

4. Findings and discussion

In what follows, we generally consider the primary schools as one loose group and the secondary schools as another loose group. We will argue that the evolution of the attitudes and beliefs of the teachers is shaped by how the pocket PCs were introduced in the five schools, the subject areas in which the teachers integrated pocket PCs in the students’ learning and the attitudes of the students toward the use of pocket PCs.

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<td><strong>Term 1</strong></td>
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<td>- Teacher familiarisation with pocket PCs</td>
<td>- IT support staff creates e-bytes</td>
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<td>Preliminary observations</td>
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* First focus group interview was conducted in the second week of term 3, year 1.

* Second focus group interviews with teachers and students were conducted between the last week of term 4, year 1 and the second week of term 1, year 2.
4.1. Implementing pocket PCs in classrooms

Our observations and interview data show that the pattern of implementation of the technology in the three primary schools was not identical. PrimSch1 located the pocket PCs in a shared computer laboratory, which was accessed by all students, but only a limited number of classes made use of the pocket PCs. The pocket PCs were stored in a cupboard with cradles set up for recharging the devices after they had been used. PrimSch2 located their pocket PCs only in a composite grade 5/6 class taught by two volunteer teachers. The pocket PCs were charged in the computer laboratory and brought into the classroom on a daily basis. In PrimSch3, the pocket PCs were located in a central computer laboratory, but different teachers in selected grade levels took responsibility for targeting groups of (8–12) students in different curriculum areas.

As the three primary schools had a history of co-operative activity despite being in different parts of Melbourne, there was a shared appointment of an experienced IT support person, who took a leading role in advising on the implementation of the pocket PCs and in developing a variety of activities that could be used to both hone the students’ skills and to integrate with various areas of the curriculum. He was however, based at one school and access to his skills and assistance by the other two primary schools was limited. The IT support person worked with a lead group of students to develop “ebytes”. He established a pocket PC learning website that allowed staff to access the weblogs of other participating staff members. It also contained other useful information such as ‘PDA tips and tricks’, ebytes and sample pocket ebytes work from students. The ebytes activities were used extensively by staff in the primary schools and served as a model for the subsequent creation of ebyte learning materials. However, the secondary teachers thought the activities too simplistic and unsuitable for years 7 or 8 students.

The two secondary schools worked independently and did not have access to the IT support staff from the primary schools. In these two secondary schools, the implementation of pocket PCs depended on the enthusiasm of particular individuals. The two teachers in SecSch2 were enthusiastic about the idea and integrated the technology in their classes. There was no previously existing enthusiasm in SecSch1 and little incentive for teachers to take up an additional initiative. Unlike the experience in the other four schools, the initial focus group interview indicated that SecSch1 staff had had little input into the decision to adopt pocket PCs. The initiative and energy in this school seemed to lie with the principal, who, however, did not employ or allocate additional technical support. In the other schools, the wider staff was involved in discussions about which year levels or students would use the pocket PCs.

The level of support from the principals varied greatly between the primary and secondary schools. The secondary schools did not appear to have the same level of planning or professional development as the primary schools. While the principals in the secondary schools held a belief that pocket PCs could assist with learning, particularly with the weaker students, and were keen to adopt the new technology in their schools, they were almost inactive in assisting with the framing of a support structure for the staff. Financial support was provided to one secondary school, where several thousand dollars were spent on purchasing data logging equipment. However, this equipment had not been used at all by the end of the research period.

The principals of the primary schools were more proactive in shaping the pocket PC program, in soliciting advice and support from software and hardware suppliers, recruiting support staff and visiting schools and interest groups around the world prior to the project. The secondary school principals were less proactive, relying on the IT support staff and volunteer teachers to work out the technical and pedagogical issues.

Security in terms of their ability to protect the pocket PCs from being lost or stolen was initially a strong concern of the secondary teachers. However, security was not a concern for the primary teachers. For one of the secondary schools, security remained a concern throughout the period. Another issue in the implementation stages with shared usage of the pocket PCs was the training of both staff and students. Financial support was provided in different curriculum areas.

4.2. How teachers integrated pocket PCs into the curriculum

Derived from observations and interviews, Table 2 shows the numbers of teachers and students using pocket PCs and the curriculum areas where the devices were used. English, science and mathematics were the most common curriculum areas where both the primary and secondary teachers integrated pocket PCs. The primary schools made use of the devices quite consistently throughout the research period.

Use in the secondary schools was more varied. In SecSch2, one science and one humanities teacher trialled the pocket PCs with one year 7 and one year 8 class. At SecSch1, an English teacher and another ESL (English as Second Language) teacher used the pocket PCs with small groups of students. These secondary teachers were self-starters and driven by a view that the pocket PCs were motivating objects capable of bringing about improvement in learning. These teachers reported that their efforts became too onerous as the trial period proceeded and lack of colleagues to share ideas with led to steadily reduced usage of the pocket PCs. Illustrative of this was that the science teacher in SecSch1 did not use the pocket PCs despite substantial amounts of money being spent on purchasing data logging equipment.

In the area of literacy, primary students undertook ebytes tasks, downloading the movies themselves to individual pocket PCs but the task instructions were copied from the desktop computer by (1) typing them into the individual pocket PC using the devices’ virtual keyboards or transcribing them with the stylus, or (2) reading the instructions and voice recording them into the pocket PCs for later replay when the students moved away from the desktop computers. The latter was a more popular choice due to the slow nature of writing on the keyboard or transcribing.
The students also used the voice recording capacity of the pocket PCs to practise their oral presentations and the expressive aspects of speech. They used the pocket PCs to compose poems, write small pieces of text such as persuasive letters to the principal and undertook an ‘Authors Project’ seeking information from the Internet using the wireless function of the pocket PCs.

We did poetry before for term 2 and we had to get the kids into public speaking roles. It was better when they could hear themselves. (PrimSch1 Teacher #2)

The biggest impact of the pocket PCs on student learning appears to have been on students with low literacy skills. At both primary and secondary levels, teachers reported:

The biggest benefit is I’ve got a couple of boys who are not quick writers. Now they keep up with the class and they love the sessions because they can voice record (PrimSch3 Teacher #7)

For student X and also student Y, technology helps with their willingness to spell. Student X is now typing out sentences. This is a tool for his future as he is unlikely to write much. He also records his reading. I’ve made a file on the main PC to record and see over time if he really will improve. (SecSch1, Teacher #10)

Both primary and secondary teachers made use of the pocket PCs in science. In a science class that was observed, year 7 students used both pen and paper and pocket PCs to write and draw. The students used Word Mobile to write short summaries and Excel to calculate the cost of materials, such as newspapers, balloons and masking tape, to be purchased for an “egg-landing-safely” problem-solving task. Many chose to pencil-draw their design on A3 sheets of paper rather than to use the sketch pads on the pocket PCs. The engagement level was high. However, as the pocket PCs were not a natural part of the students’ learning, the teacher had to work hard to give clear directions, and move around the room extensively to assist with both technical and academic issues.

Other examples of science learning using the pocket PCs at the primary level included studying erosion outside the classroom, treasure hunting and forensic science. One teacher reported making short video clips using Movie Maker on her laptop and setting the investigative tasks with structured instructions. Instructions given in video format were used frequently with the primary teachers. An advantage of video-based instruction was that the teacher could integrate images and short video clips (for example of whales swimming) and construct questions around them. The pocket PCs were used for voice recording data, for example, in a detective role-play for the forensic science project, the students recorded their interviews with teachers to find out who had stolen the laptop.

There were no reports of pocket PC use in secondary mathematics classes. In the primary schools, the pocket PCs were actively embraced as part of numeracy learning:

I created task cards so the students had activities written down on a piece of paper to follow. These included a combination of directed and open ended tasks so the students were able to follow through the tasks set, then make up their own activity based on these. ... my tasks were mainly number based. I did do some shape ones as well. ... the highlight of one shape task was the students just walking around outside working freely. ... the engagement level, the support and the networking amongst the students was fantastic. (PrimSch2, Teacher #4)

Activities observed in mathematics classes include exploring size and shapes outdoors and relating them to their uses. Excel spreadsheets were used to graph weather (temperature) patterns over a week and for other statistical investigation such as the investigation of the number, brands and colours of cars in the staff car park.

In embracing pocket PCs in their teaching, the teachers reported seeing themselves as enabling students to learn content and skills across the curriculum, an essential feature of the state’s curriculum framework. For example, SecSch2’s “land-an-egg-safely” problem-solving task required an understanding of concepts of forces and motion, insulating properties, materials science, business/maths skills to work out costs and skills to creatively design a protective device from simple materials. These were integrated into developing students’ thinking, communication and technology skills. The pocket PCs were part of the learning experience for data collection, jotting down notes and
calculating costs using Excel to work out the different variations of materials they could purchase with the limited amount of money provided in order to construct an egg-protecting device.

Another learning task that integrated diverse parts of the curriculum was in physical education in PrimSch1. Students used science and mathematics skills to collect their pulse rates and graph them, to conduct an investigation of their own fitness over time.

A concept mapping tool was also used to demonstrate different levels of thinking in PrimSch3. Fig. 1 shows an example of an early version of a concept map on the topic “Ocean Safari” collected from a year 4 student activity that was observed. The map shows that students of this age are quite easily able to make use of the pocket PCs to record extended representations of categories and sub-categories. The links within the map extend substantially beyond what would be visible on a single screen, but retain coherence in categories and consistency of formatting. The level of thinking, however, was not sufficiently explicit as the linking words/phrases between keywords were missing. Hence it is unclear if ‘sharks’ is a member of the class of ‘fish’ or linked because they eat ‘fish’, ‘whales’ and ‘dolphins’. The students and their teacher in the class had not discovered how to insert the linking words at this time, which was at the end of the research period.

4.3. Student attitudes

Three focus group interviews were conducted at the end of the research period with students from the three primary schools. The secondary schools did not get around to organizing students for interviews with the researchers. The primary school focus group interviews had 6–8 students participating. In the interviews the students identified uses in English, mathematics and science classes as described in Section 4.2. The interviews indicated that students were generally positive in their reactions to their experiences with the pocket PCs. For example,

PrimSch2, student #11: It’s like a mini computer
Interviewer: Is it as good as a computer?
All children: Yes
PrimSch2, student #13: It has internet and everything. It’s really good

They had approached the use of the pocket PCs with expectations based on their prior experiences with other computers. Some had initial expectations that the pocket PCs had the same capacities as other computers only to discover their limitations and specific requirements. Some of their expectations led to frustrations, some to general learning and some to new discoveries. Mixed positive and negative reactions to software issues were accompanied by mixed reactions based on the physical attributes of the pocket PCs. For example:

You can’t do windows movie maker, you can’t do those things that you need to use a mouse with and all those other complicated things, you have to do it with a computer. The pocket PC one is more simple. (PrimSch2, Student#6)

PrimSch2, Student #10: You have to get used to working them and all that and getting them into the right things.

Fig. 1. Ocean Safari concept map using pocket PC.
The students’ experiences with computers meant that they knew that the pocket PCs would give them the ability to easily change what they wrote or drew. In contrast to their experiences with paper, these students saw the pocket PCs as offering a risk-free ability to record their thinking (because they could readily amend whatever they recorded). For this reason, they found the pocket PCs positive and encouraging. For these students, the relatively small screen size was not an obstacle since they could scroll around to locate material that was not within their immediate vision.

While interactivity and sending messages or files via Bluetooth were not issues with these students, the expectation of ready access to the Internet was often frustrating due to the instability of wireless connectivity and when this and other expectations were not as readily met as they had anticipated, the students expressed their frustrations about the limitations of the pocket PCs.

Whereas on the actual desktop you can go to the Internet and download games and you can store more programs onto the computer and there’s more memory. (PrimSch1, Student#4)

Similarly, frustrations were expressed in relation to the switching between multiple applications opened simultaneously when both teachers and students were not aware of the ‘switcher bar’ function:

… with the computer you can move down the bottom from program to program, with this one you need to close the program and then go to the next one. (PrimSch1, Student#4)

This was not a consequence of unfamiliarity with manipulating technology:

PrimSch1, Student#3: You can’t minimize anything.
PrimSch1, Student#2: But they automatically minimise even if you press the ‘X’ button because if you go into settings, memory and then you go to running programs and you choose which one you want to go into. If you close it off, it never actually closes off until you stop them all.

The small size of the pocket PCs was seen as a real advantage by the students because of their ability to take them outside the classroom or to walk around in the classroom to record notes. The multimodal capacities were also seen as advantageous:

PrimSch1, Student#1: We mainly use it for recording. It has a button so we can speak into it.
Interviewer: What do you do with that?
PrimSch1, Student#4: jot down notes.
PrimSch1, Student#5: We used it once in the science room and we did the experiments and we jotted down notes and it was really quick and easy.
Interviewer: You mean jotting down by just recording it?
PrimSch1, Student#5: Yeah, you can do it with voice or by typing it.
PrimSch2, Student#6: We could record. We did like personal little tell things that worked and we did summaries. And we record it and beam it to our teachers. And then we did some of these writing things. Sometimes you have to draw pictures on the pocket PCs and we send them to our teachers.

However, there were also frustrations:

School P2, Student#6: When you try to write [using the stylus for handwriting] and it turns into actual writing on the computer, it’s very difficult because you have [to use] the exact type of handwriting they use, so it’s very difficult.

The combination of reactions that emerged as the students adjusted their understanding of pocket PCs from a general understanding of computers to a more specific understanding of pocket PCs was part of their general learning. The students commented on the ability to make changes to their representations as the most positive feature. Combined with the capacity for personalisation through mobility, the students experienced the pocket PCs as beneficial and were willing to work with the relative limitations of the pocket PCs in comparison to desktop machines. They also developed an understanding that pocket PCs could be usefully combined with other forms of ICT, such as taking images with a mobile phone or digital camera that could be downloaded or sent via Bluetooth to their pocket PCs, so that those multimodal capacities of the pocket PCs could stand in their own right as advantages for learning.

4.4. Attitudes and beliefs of teachers toward pocket PC at the first focus group interview

The integration of technology into classroom curriculum goes through multiple steps (Sandholtz, Ringstaff, & Dwyer, 1997): entry; adaptation; appropriation and invention. Within the first two months of the introduction of pocket PCs, many teachers had conquered the first step and were well into the second level of integration in their classroom teaching. In the first focus group interview, both the primary and secondary teachers’ attitudes toward the use of these devices were overwhelmingly positive (see Table 3). Most of the teachers had begun exploring the different features of the pocket PCs with some teachers having started to create their own learning materials and trialling them with the students. The primary school teachers were positive about sharing their learning with colleagues and students:

“We were starting on a par with them so we spent a lot of time playing and figuring out how things worked before we used them for a specific purpose. … (this was) positive as the kids were showing us things and we were showing them things.” (PrimSch2, Teacher #3).

They were also positive about the challenges of integrating pocket PCs into their classes. This involved how the classroom would be structured, how the curriculum would be delivered and how the students could access, manage and control their own learning. In contrast, SecSch1 at this first focus interview had yet to start opening the boxes containing the pocket PCs. They shared concerns with SecSch2 about security of the pocket PCs and how to prevent them from being lost or stolen.
At this initial stage of the teachers’ integration of pocket PCs into the curriculum, both primary and secondary teachers agreed on the motivational aspect of the devices. However secondary teacher #13 (SecSch2) expressed the need for teaching and learning to move beyond the ‘novelty’ factor to maintain motivation in the long run. Other beliefs that the primary and secondary teachers reported in the interviews about the use of pocket PCs included:

1. Students being intuitive with the technology, indicating some commonality with Prensky’s (2001) description of the younger generation as ‘digital natives’. They were able to pick up the skills to use the technology easily and could use appropriate terms such as ‘stylus’ (as opposed to some teachers calling it a ‘stick’), ‘beam’, ‘bluetooth’ and ‘synch’.

2. The potential of the pocket PC to produce change in students’ learning. The device was seen as a motivational tool and as having advantages over the use of pen and paper or the laptop and desktop. For example:

   (a) its portability meant that students could spend time outside the classroom using the instructions for investigating and learning:
   
   The biggest advantage is mobility and 24/7 access as it is not possible that there is a computer in front of every student. (SecSch1, Teacher #11)  
   
   … you can take it anywhere, don’t worry about power points. Set an activity for one student and another one for another student. These can be explored on, they turn on the button and there is no need to log in. They can work in a small space. PDA in palm is a great thing. (SecSch2, Teacher#10)  

   (b) the interactive potential of the pocket PCs meant that students could learn from animations, simulations and videos, hence engaging all senses

   (c) the pocket PC offered students more independent learning in a more personalised way brought about by its ability to access the Internet, to voice record, and students being able to undertake extension work within the developed ebytes materials; and also the students could make low-risk mistakes

   They’re not afraid to make mistakes.  …they really open up the opportunity for them to make mistakes and learn from them. (SecSch 2 Teacher #13)

   (d) increased engagement and socialization levels of the students. The primary teachers described their students’ willingness to learn from each other and to share their knowledge, which could spread ‘exponentially’. For example:

   I also found that the kids … were a lot more focused and on task when they had a pocket PC in their hand. (PrimSch2, Teacher #5)  

   Yeah, another benefit has been some of my shy children, because I have a very set back approach. I don’t help them very much. They’ve had to start asking questions and engage with their peers a lot more and it has been great to watch. It’s quite non-threatening because they’re looking at the pocket PC they don’t have to make eye contact. They can ask questions and also answer questions. Particularly one of my girls who hasn’t spoken much has taken on a leadership role. It has been pretty cool to watch … for her that’s the most communication she has done with another person. So I thought that was a big break through. (PrimSch1, Teacher #2)

4.5. Highlights, challenges, attitudes and beliefs of teachers toward pocket PCs after commencing integrating pocket PCs in their classes

In the second focus group interviews at the different schools, after about 6–7 months of working with the pocket PCs, the teachers were asked about the highlights and challenges they had faced. Together with observation notes, the interviews elicited the teachers’ attitudes and beliefs about pocket PC usage in their classes. A total of 11 teachers were interviewed with one teacher from PrimSch3 and one from SecSch2 absent when the interviews were conducted. The highlights cited by both primary and secondary teachers were mainly in the literacy areas, where low literacy students who ‘did nothing before’ were beginning to voice record and write with the pocket PCs. Another highlight for the primary teachers was in the shift from using the IT support staff’s ebytes to developing
their own ebytes, creating times tables, e-books in PowerPoint format for mathematics and other instructional materials such as a forensic science problem to be solved using features of the pocket PCs, for example, voice recording the interviews with ‘suspects’ for analysis later. The ebytes the primary teachers created contained instructions for tasks in multimedia format in PowerPoint or movies (using moviemaker software on a desk/laptop to create and download).

One of the challenges that both primary and secondary teachers faced was the creativity that was needed to develop material that capitalizes on pocket PCs usage in 60–120 min of lessons per week. Another challenge faced by both groups of teachers was transferring files to students using Bluetooth, which they found slow and unreliable. A further challenge the secondary schools faced was ‘controlling of the equipment’. They needed to set up dedicated areas to charge the pocket PCs and to synch with the desktops. By the end of the research period, SecSch1 had a table set up for charging with sufficient access to power points while SecSch2 was still considering the problem.

Teachers’ attitudes towards pocket PCs in their classrooms at the end of the research period differed between primary and secondary teachers (see Table 3). Of the seven primary teachers who participated in the interviews, the data in the table shows that three remained positive, three had positive but cautious attitudes while one teacher was sceptical about the value and potential of pocket PCs in the classroom. Positive attitudes related to the use of pocket PCs in engaging students with learning and fostering teamwork between students and between staff. Teachers displaying mixed attitudes embraced the positive dimensions of motivation and collaboration but also had concerns about the time-consuming nature of lesson preparation incorporating pocket PCs. The small screen size frustrated the mathematics teachers who indicated that when the spreadsheets became larger, there was a need to scroll back and forth as the screen was unable to display the whole sheet. Other frustrations included the glare on the screen from the sun when working outdoors, making viewing on the screen difficult and the lack of (PrimSch1 and PrimSch2) or unreliability of access to the Internet (PrimSch3). The teacher (#7) from PrimSch3 also indicated frustrations due to the need to scroll back and forth in web pages that were downloaded onto the pocket PCs even though the students interviewed from the same school did not seem to be bothered by it. There were also some concerns from the primary teachers that some of their students were getting somewhat bored with some of the materials that had been developed and similar tasks being done over and over again. Girls and the more academic students were identified as the ones showing signs of boredom. This teacher observation was matched by what students said in informal interviews during observation visits by the researchers. The teacher who was sceptical about pocket PCs commented that ‘I think it is a useful tool but everything I’ve done this year I can do without them, except engagement. Teachers need to make sure there is a purpose for using them.’ (PrimSch1, Teacher #3).

As Table 3 shows, the attitudes of the secondary teachers were characterized by uncertainty. They were uncertain of the potential of the pocket PCs due to the lack of both technical support and interested teachers in each of the curriculum area to plan, explore and support each other in the use of these devices. SecSch2, teacher #12 indicated that “... it’s controlling the equipment as well. That’s a big job to do, making sure you’ve got all the power points, they are charged and all those sort of technical issues. We’ll have to sit down with (principal) and figure out where the focus is.”

The only secondary teacher who accessed the Internet with the pocket PCs reported similar inconsistent experiences to those of the primary teacher PrimSch3, teacher #7. She was frustrated with its unreliability and the need to scroll back and forth to view the webpages. None of the secondary teachers made use of the Bluetooth function. According to SecSch2, teacher #12, there were concerns that students would send inappropriate messages to each other.

Both the primary and secondary teachers believed that the pocket PC was a motivating tool that could engage students, promote good behaviour and encourage both independent learning and teamwork (see Table 3). A positive impact, as indicated in Section 4.2, that both the primary and secondary schools believed in was that the devices had the potential to cater well for students weak in English. The reverse belief that the pocket PCs were less useful for academic and higher achieving students were expressed explicitly by PrimSch1 Teacher #2 and SecSch2, Teacher #12. Another belief that was indicated by the primary teachers was the need to allow for more open and purposeful usage of the devices, that is, usage when needed in a manner decided by the students themselves. Rich pedagogy was seen by several teachers (primary and secondary) as not using the pocket PCs only for the sake of using the technology.

### 4.6. Looking to the future

Both primary and secondary teachers identified problems associated with the use of pocket PCs for the future. They were aware that more challenging tasks needed to be constructed for students who had used the pocket PCs for a period of time and that more support was needed to pursue this, including purchasing larger SD cards, installing more applications, a built-in camera to capture images for reports and visual art tasks, preventing the glare on the screen from the sun when used outside to improve visualisation, getting more technical support for software applications, professional development for the use of these applications and personal ownership of a pocket PC by each of the students.

*They don’t connect with it, they don’t see it as theirs, they don’t see they can have access to it whenever they want and therefore make it to be what they want it to be. So just because I haven’t thought of it doesn’t mean they wouldn’t think of a really useful way of using it but if they’re limited by how often they can access it...my kids for instance every time they access it they have to remember certain things. Interacting with the tool is not intuitive yet because it’s not theirs. It’s a lot about ownership.* (PrimSch1, Teacher #1)

### 5. Conclusions and implications

This study tracked the introduction of pocket PCs into three primary and two secondary schools within the first year, from purchase of the devices, preparation and planning for classroom teaching to 6–7 months of actual integration into classes. The focus of the study was on how attitudes and beliefs evolved over the months of usage in the classes and what shaped these attitudes and beliefs. The research has indicated differences between primary and secondary schools’ practices in terms of collegial and technical support. The apparent ‘success’
of the primary schools in adopting the technology lay in: (i) a clearer view, led by principals, of the place of the pocket PC program in their schools (ii) a more conscious, concerted and collegial effort by teachers to plan and integrate the technology into their curriculum and (iii) the investment in the IT support staff dedicated to the adoption of the technology. In contrast, the ad hoc adoption was due to the lack of a “critical mass of teachers to get anything going” (SecSch1 Teacher #6). The differences are also a reflection of the differences in the nature of primary and secondary school settings. The support of IT personnel was lacking in both secondary schools. This together with the lack of ‘release time to explore usage and search for useful applications or collegially plan programs that could be used in the classrooms’ (SecSch1, Teacher # 10) resulted in less advancement with the pocket PCs in the secondary schools. These findings are not dissimilar to the findings of McFarlane, Triggs and Yee (2008, p. 9) where the introduction of 1:1 mobile devices has been more problematic and complex in secondary schools than in primary.

The findings suggest that, while most of the primary and secondary teachers were still positive about the use of pocket PCs at the end of the research period, especially as a motivational tool to engage students, there was a substantial level of uncertainty. The uncertainty and concerns teachers indicated included the physical limitations of the pocket PCs (small screen, sun glare), effective pedagogy to cater for all students and the need to invest in infrastructure, technical support and software purchases.

From the perspective of learning with pocket PCs, there was realisation of a need for more innovative strategies to integrate more challenging and higher-order thinking tasks that allow students to learn independently. For example, Acrobat reader was not installed to enable e-books and e-readings in PrimSch3 and the data logging sets were not utilized for exploratory investigations in SecSch1. There are on the World Wide Web many cost-free applications for pocket PCs and a simple stopwatch software could go a fair way in injecting interest into student learning, for example in physical education and science and mathematics classes. These resources were not explored.

At the technical level, there is a need for more memory, integrated cameras and educational software to be installed and more technology support at both technical and pedagogical levels. It is important that these needs are realised and, as Roschelle (2006) argued, the uptake of technology will fail if teachers’ lives become more complex. He argued (p. 18) that effective integration of technology in schools requires that the technologies enable innovation, make life easier for teachers and provide a pathway to adaptive expertise:

No technology can suddenly transform a teachers’ level of adaptive expertise. But well-designed technology can provide a pathway for growth, whereby as teachers use the technology they can gradually transform to become more adaptive and more expert in helping their students learn.

The steps required to reach this level of use would require that the ultimate pedagogic purpose be clearly established prior to the implementation of the project and that administration, teachers and students are participants in shaping both the goals and the means of overcoming the various challenges. The challenges are technical, financial, logistical and theoretical, but as the experiences of these diverse schools have shown, not insuperable. Progress, particularly at the secondary levels, requires improved communication, expert technical support, recognition that learning will come from a variety of sources and consideration of the other levels of technology that will be required to support the pocket PCs, e.g. wireless access and interactive whiteboards. Each of these has other logistical and financial implications that need to be recognised prior to commencing implementation. The experiences of this group of schools indicate that implementation will take much more than six months before more creative uses of the pocket PCs can be regularly and widely implemented.

In concluding, effective planning with the school community prior to and during the implementation of technology is crucial for successful uptake in the classroom (Czubaj, 2002; Gulbahar, 2007; Mauer & Davidson, 1998). The way for this group of schools to move forward includes: (i) investing further in carefully co-ordinated hardware, software, professional development and technical support with an understanding that no single piece of technology will do everything; (ii) building a network of pocket PC users for support and idea sharing which will save time and alleviate the frequency of re-inventing the wheel; (iii) teachers undertaking action research based on a cycle of purpose, design, trial, evaluate, trial, redesign, re-trial as an effective way of improving teacher’s practice and (iv) students getting more access to the pocket PCs to induce more natural and powerful blending of general learning with learning using the pocket PCs.

It starts with ownership. If you are serious about introducing pocket PCs into the classroom, into the curriculum, you have to give every child and every teacher their own. They have to have their own, and from there you need to make sure they have a very solid curriculum that actually provides purpose for the use of the tool. That’s got to come before you give ownership, otherwise you’d put the cart before the horse. (PrimSch1, Teacher #1)

Appendix

Focus group semi-structured questions (preliminary)

1. Do you have example of successful practice with the PPCs at this stage?
2. What changes have you made to your planning and teaching practice?
3. What changes do you think you will need to make in planning and/or practice to move the project forward?
4. What do you see as the advantages of using PPCs in your class (a) for you; (b) for the children?
5. What worries you most when you think about you or the students using PPCs?
6. What further support is necessary?
7. How do you feel you are progressing in making the PPC an integral learning tool in your classroom currently? …. And for the future?
8. What are the strategies that schools are using to monitor student use and what are the rules for use e.g. damage and responsibility of the PPCs?
9. What are the current or potential inhibitors to this project?
Focus group semi-structured questions (end of research period)

1. What are the highlights and challenges that you have experienced with the use of pocket PCs in your teaching?
2. Tell us about rich pedagogy.
3. How has your thinking changed as a result of using the technology in your classes?
4. What are the ways forward?

References


