A current phenomenon in Australian school education is the rapid adoption of Interactive Whiteboards (IWBs) as a multimedia teaching-tool. Existing research (predominately from the UK) has mostly focussed on the impact of IWBs on student engagement, with some attempts being made to assess effects on academic performance. A critical aspect that remains under-researched is the complex area of the teacher’s IWB pedagogy and the consequences for learning environments. This symposium presents for discussion, the findings of five small-scale studies conducted by a group of Honours students that used a variety of qualitative methods to investigate different aspects of IWB pedagogy from a range of educational perspectives: a) Classroom interaction patterns, b) Teacher attitudes and age, c) Development of pedagogy, and d) Teacher creativity. Collectively, these studies offer a range of viewpoints on the use of IWB for teaching - from primary students, teachers, a principal and an IWB trainer, as well as observations of classrooms. The purpose of the symposium is to present the overlap of findings from these seemingly diverse studies as well highlighting the unique findings. Finally, against the background of existing research literature, several key questions are be suggested for further discussion and research.

Introduction

Internationally, over 750,000 interactive whiteboards (IWBs) have already been installed in classrooms and over three million are anticipated to be installed by 2010, with Australian national and state government technology initiatives pushing for at least one IWB in every school (White, 2007). Since IWBs have been introduced into classrooms globally, there have been fervent claims by policy-makers that the IWB has the potential to ‘revolutionize’ pedagogical practice (Gillen, Starrman, Littleton, Mercer & Twiner, 2008; Miller & Glover, 2002; Smith, Higgins, Wall & Miller, 2005). Considering the previous resistance of many teachers to integrate technology into their general pedagogy (Cuban, 2001; Baskin & Williams, 2006; Way & Webb, 2007), the more willing uptake of IWBs (Cuthell, 2003; Glover & Miller, 2001a; Gillen, et al. 2008) raises questions about teachers’ views about this new teaching tool. Accordingly, the impact of this relatively new resource on teaching and learning is of great interest. Existing research (predominately from the UK) has mostly focussed on the impact of IWBs on student engagement, with some attempts being made to assess effects on academic performance. Although useful research findings have begun to emerge, a critical aspect of educational technology that is currently under-researched is the complex area of the teacher’s IWB pedagogy and the consequences for learning environments (Gillen et. al., 2008; Glover & Miller, 2001a; Hall & Higgins, 2005; Wood & Ashfield, 2007).

This paper, after presenting an overview of current research in the field, reports on five specific studies conducted in different primary school contexts. The focus then shifts to identifying some common themes, pointing towards important research directions regarding pedagogy with interactive whiteboards.

Review of Research

Functions and Affordances of the IWB
The IWB is a combined input and projection system, that can be operated via the computer keyboard and mouse, or, more importantly, by tapping on the screen image. The software run on the computer provides a variety of functions, including those which replicate non-digital technologies such as flip-charts, dry-wipe boards, overhead projectors, slide projectors, video-players, and other functions which have not previously been possible on a large, vertical display. Prepared presentations can be displayed or resources can be altered or created on-screen and saved as computer files for future use. As well as accessing software
applications, the IWB allows the use of multimedia resources such as VCR, CD ROMS, audio CDs, DVDs and a range of peripheral technologies such scanners, digital cameras, microscopes, data-loggers and hand-held electronic voting devices. When the computer is connected to the Internet, the access to information, communication facilities and digital resources expands enormously. Therefore, the IWB facilitates the convergence of a wide variety of digital technologies.

The term *affordances* is used to refer to the design features in a technology environment that can support or constrain ‘doing’ or learning. Different features offer different opportunities for the user to interact with the material being presented. The affordances may reside in built-in technical tools, software packages, Internet learning objects, websites, pieces of multimedia or connected peripheral devices – all of which converge in the IWB. The interactions afforded can be described in a variety of ways, such as being physical, functional, sensory or cognitive affordances (Harston, 2003).

In general, the educational purpose for using IWBs in the classroom is to enable access to and the use of digital resources for the benefit of the whole class while preserving the role of the teacher in guiding and monitoring learning (Hall & Higgins, 2005). The entirely functional touch-screen provides the opportunity for teachers to actively engage students by encouraging them to demonstrate their skills and understanding through operating the IWB (Kitson, Kearney, & Fletcher, 2005; Glover, Miller, Averis & Door, 2005). Teachers can utilise visual, auditory and tactile features of the IWB in order to suit pupils’ needs (Glover & Miller, 2001; Beeland, 2002; Bell, 2002; Neil, 2005). Numerous researchers have acknowledged the IWB’s diversity of visual affordances including its large size, movement, bright colours, computational graphics (Davison & Pratt, 2003; Wall, Higgins & Smith, 2005) and its ability to be connected to other equipment (Benjamin & Hughes, 2006). Particular studies suggest the facility of IWBs to present information in sharp colours, and to annotate, conceal, manipulate, move and zoom in on images enhances the learning process and pupils’ recall of information (Bell, 2002; Burden, 2002).

**The teachers and the teaching**

A driving factor behind research into the IWB phenomenon in schools is that the interactive whiteboard is a tool directly relating to teachers and their pedagogy (Hall & Higgins, 2005). Unlike other technologies, it is not intended for individual learning but for whole-class use (Hall & Higgins, 2005). Therefore it is likely to impact on pedagogy. Of particular interest is the effect the IWB is likely to have on whole-class teaching, whole-class interactivity and on the pedagogical outlook of teachers themselves. Regular use of an IWB in teaching has the potential to shift classroom dynamics, but there has been a polarisation of research findings regarding the nature of this shift. At one extreme, is teacher-centred practice with the teacher dominating the control of the IWB functions, one-at-a-time student interactions with the IWB and low levels of inter-student communication (Kennewell, 2006; Miller & Glover, 2002). Critics of this general pedagogical approach claim that the student interactions are often superficial and so are not conducive to deep understanding or higher-order thinking. At the other extreme IWB use involves student-centred practices with high levels of student collaboration and communication around interaction with the IWB (Shenton & Pagett, 2007; Wood & Ashfield, 2008), advocated as facilitating a more productive learning environment.

A number of studies have found that the introduction of an IWB into a classroom may initially either reinforce teacher-centred pedagogy or result in a shift in pedagogy towards more teacher-centred activity (Kennewell, Tanner, Jones and Beauchamp, 2008; Miller & Glover, 2002; Vincent, 2007). Although the IWB allows lessons to take on a faster pace, less time is being spent in group work and there is a tendency for educators to assume a position at the front of the classroom to control the lesson, resulting in mostly teacher-pupil interaction and little pupil-pupil interaction (Hall & Higgins, 2005; Zevenbergen & Lerman, 2008). However, there is also evidence that when a teacher’s pedagogical style is matched to the affordances of the IWB, the level of interactivity and student learning can be enhanced (Lee & Winzenried, 2006; Tanner, Jones, Kennewell, & Beauchamp, 2005; Vincent, 2007). While some researchers emphasise the power of the IWB’s functionality to trigger interactive teaching methods (Shenton & Pagett, 2007), the general argument seems to be that interactivity is achieved through the teacher’s choices in teaching style rather than what is presented via the IWB (Chin, 2004; Kennewell, 2006; Knight, Pennant & Piggott, 2004). The IWB serves as a tool that mediates pedagogy through the affordances it offers (Miller & Glover, 2002; Zevenbergen & Lerman, 2007) and so when a teacher begins to utilise the IWB’s capabilities to cater for the diversity of learners in the class, the potential for the IWB to transform pedagogy is revealed (Tanner et al., 2005). However, pedagogy and classroom dynamics are complex and a range factors, such as teachers’ various beliefs about learning, their motivations towards technology and their willingness to develop new materials will influence the ways in which a teacher might choose to use the IWB’s affordances to enhance learning opportunities for students, and hence affect the potential for pedagogical change (Miller & Glover, 2002; Zevenbergen & Lerman, 2007).
The need for professional development opportunities that go beyond the technical skills and explore pedagogical issues is emphasised in the literature (Lee & Winzenried, 2006; Levy, 2002; Shenton & Pagett, 2007), particularly regarding the promotion of student-centred activities, varied interaction patterns and increased discourse. Kennewell, et al, (2008) suggest that it is important to reflect not only on pedagogical interactivity, but other aspects such as learning styles, student engagement, assessment and behaviour management.

The learners and the learning

Traditionally teachers using technology in schools have been encouraged to dramatically change their teaching practice, often reducing their role in the teaching process (Kent, 2004). Instead, IWBs allow educators to interact in new ways with the content of the lesson without necessarily changing pedagogy (Kent, 2004). This is in contrast to Chin (2004), Kennewell (2006) and Knight, Pennant & Piggott (2004) who encourage the idea that teachers should not be seeking to interact with the new IWB technology themselves, but rather use IWBs as a medium to allow the class to interact with each other using new teaching and learning strategies offered by the technology. Perhaps the essence of this apparent conflict of opinion is whether the IWB is perceived as a teaching tool for teachers or as a learning tool for the students.

Educational theories such as social constructivism affirm that self-directed learning plays a key role in improving the quality of students’ learning experiences, yet it is argued that within the context of whole-class teaching, individual student autonomy is constrained by the need to develop collective knowledge and understanding (Kennewell et. al, 2007). In whole-class teaching, students may find it easier to adopt a more passive role to their learning, particularly if student participation with the IWB is superficial, such as routine manipulation of items on the board by dragging and dropping (Kennewell, 2006). In addition, this type of activity tends to decrease opportunity for social interaction and collaborative learning Zevenbergen & Lerman (2008). However, some researchers have found that when the full interactive potential of an IWB is realised, it can instead promote the desired social-interactive learning environment (Wood & Ashfield, 2008). Kennewell (2006) further suggests that if material is constructed during the lesson with students, this results in shared ownership of the learning as well as higher levels of interactivity with the lesson content. In contrast, other researchers favour the use of pre-prepared resources from software programs or the Internet in teaching lesson content because direct links between media and information can be made, and the learning can be well sequenced (Beauchamp & Parkinson, 2005; Shenton & Pagett, 2007).

Much of the research reporting on student learning has still been from the teacher’s perspective, with fewer studies focussed on the learner’s perspective. Hall and Higgins (2005) and Wall, Higgins & Smith (2005), through interviewing students, found they believed that games made their learning fun, easier, and changed their concepts of specific subjects. Chin (2008) also advocates the use of games on IWBs as lesson starters to promote engagement with the content and interaction amongst the pupils. Kennewell (2006) studied student’s perceptions of the IWB use in their classrooms reporting children value its use in whole-class games, Internet exploration, and multimedia presentations, because they integrate visual, aural and tactile elements. Kennewell further discovered students believe they are given inadequate opportunities to use the IWB independently, and there is insufficient equity when students are called upon to use it.

A common finding in the research is that children are engaged and motivated by IWB usage (Cogill, 2006; Levy, 2002; Shenton & Pagett, 2007; Smith et al., 2006). In particular, several studies have noted the potential for the visual capabilities of the IWB to positively affect student concentration and engage students (Beeland, 2002; Davison & Pratt, 2003; Wall, Higgins & Smith, 2005). IWBs are thought to benefit students with visual-spatial learning preferences (Cuthell, 2003; Wall, Higgins & Smith, 2005) as well as developing visual media skills in other students (Neil, 2005).

In summary

IWBs are becoming prolific in primary classrooms and have the potential to have a significant impact on pedagogy. Research so far presents conflicting findings regarding the nature of the pedagogical impact, with the major concern being that IWB use promotes teacher-centred approaches with low-level student participation. Clearly, there are two important factors in shaping the interactivity of a lesson: what features of the IWB a teacher chooses to use and how they choose to use them. One undisputed point is that the attention and engagement of almost all children are stimulated by the multimedia affordances delivered by the IWB, though different preferences for particular types of usage are emerging. The complexity of the influences on a teacher’s pedagogical choices, including attitudes, motivations, technical skills, affordances of the IWB, beliefs about student learning needs and preferences, lesson content, curriculum, physical environment, and access to professional support, make it extremely difficult to generalise research findings, making more extensive research essential for informed decision-making around this educational phenomenon.
Five Studies of IWB Pedagogy

Responding to the need for further research, and motivated by the desire to better understand the factors influencing IWB pedagogy to inform educational decisions as beginning teachers, five undergraduate Honours students selected the following aspects to investigate:

1. What are educators’ perceptions of IWB pedagogy?
2. How does a teacher’s creativity in IWB pedagogy develop?
3. What is the relationship between the choice of IWB teaching tool and classroom interaction patterns?
4. What influence does a teacher’s age have on their typology of attitude towards interactive whiteboard usage?
5. What is the relationship between IWB features and visual-spatial intelligence in students?

A brief overview of each of the five studies is presented in the following section.

Study 1: Pedagogy

Researcher: Lisa Mauric

Research aim
This research study set out to investigate different ways in which the interactive whiteboard (IWB) technology affects the pedagogy of educators. This phenomenon was explored through investigating three different perspectives offered by an experienced classroom teacher, a school principal and an IWB educational consultant, each playing a different role in bringing about changes in pedagogy.

Theoretical considerations
Some research has reported the great potential for the IWB to instigate change in teacher pedagogy and produce enriched learning environments (Miller & Glover, 2002; Shenton & Pagett, 2007; Vincent, 2007) and lead to improved student outcomes (BECTA, 2003). Other studies have emphasised the absence of sufficient skill, confidence and willingness to adapt teaching styles in many teachers (Kennewell, Tanner, Jones & Beauchamp’s, 2008; Shenton & Pagett, 2007; Zevenbergen & Lerman, 2007). The mixed results from prior studies when assessing the impact IWBs have on teacher pedagogy raise many questions about how the widespread utilisation of IWB technology should be managed in schools. With enhanced student learning experiences as the ultimate objective, there is a need for this phenomenon IWB-influenced pedagogy to be further researched.

In order for educators to reveal their experiences, beliefs and practices, they are required to reflect upon their teaching practice. Dewey (1933) characterizes reflection as a specialized form of thinking. It stems from doubt and perplexity felt in a directly experienced situation and leads into purposeful inquiry and problem resolution (Grinnert & Erickson, 1988). Inferences drawn from the observed phenomena of past experience are tested as the basis for future action (Grinnert & Erickson, 1988). Reflection in the field of education carries the connotation of deliberation, of making choices, of coming to decisions about alternative courses of action (Van Manen, 1991). The type of reflection that is suitable for this study is recollective reflection and this helps educators make sense of past teaching experiences and thus gain insights into the meanings of the experiences they have with their students (Van Manen, 1991). How subjects attribute meaning to phenomena is the initial focus of researchers rather than the investigation of the validity of those meanings (Grimmert & Erickson, 1988). The purpose of this kind of research is neither prediction nor explanation; rather, it is to explore phenomenologically how educators create what Shulman (1987) describes as the “wisdom of practice” within what Lieberman and Miller (1984) have characterised as the complex world and dynamic work of teachers.

Methods
Using a phenomenological approach, extended flexible interviews were utilized to gather rich descriptions of the perspectives of three educators. One participant was an experienced classroom teacher who has been utilising IWB technology for a number of years. The second participant was a school principal who had initiated the investment in the installation of thirteen SMARTBoard Interactive Whiteboards at her school, a school which is now recognised as a leading school within the Sydney Catholic School System for
integrating IWB technology into their programming and curriculum. The third participant was an IWB educational consultant from SMARTBoard-ELECTROBOARD who supports schools within Sydney with Training and Professional Development.

A phenomenological study describes the meaning of the lived experiences for several individuals about a concept or the phenomenon and focuses on distilling what all participants have in common as they experience a phenomenon (Creswell, 2007). The first step in the data analysis was for the researcher to ‘bracket’ her preconceived ideas about IWB pedagogy in an attempt to minimise subjective interpretation of the interviewee’s words. Participant data should not be judged against the researcher’s values or existing knowledge, but rather compared with other participant data. For similar reasons, no coding framework was generated prior to looking at the transcripts, thereby allowing the ideas and themes to naturally emerge from the participant words. To further support sensitivity to the participants own meanings judgements were based on the three indicators recommended by Sjostrom and Dahlgren (2002): Frequency (how often an idea is articulated); Position (where the statement is positioned - often the most significant elements are found in the introductory parts of an answer); Pregnancy (when participants explicitly emphasise that certain aspects are more important than others).

Results & Discussion

Although there was some variation each participants viewpoint and emphasis, analysis of the interviews revealed seven themes:

1. **Concerns about the IWB** – the major concern of all three participants was that the full potential of the IWB’s characteristics were not yet being realised by teachers and that it was difficult for many of them to ‘keep up with the technology’ –which is similar to the findings in other research (BECTA, 2003; Miller & Glover, 2002; Shenton & Paget, 2007; Smith, Hardman & Higgins, 2006). The concerns included ‘misuse’ by teachers by over-using functions that simply mimic chalkboard techniques with low-level student interaction.

2. **Pedagogical change** – all three participants had witnessed changes in pedagogy, mostly of a positive nature – which they defined as the teacher ‘letting go’ of control and facilitating more student-centred practices. The consultant also identified as a key factor the need for the teacher to focus on engaging with the curriculum content of the lesson rather than emphasising the presentation. The notion of the IWB being a potential catalyst for productive shifts in pedagogy, but requiring the conscious and willing effort of the teacher and a ‘shift in power’ to take effect, is strongly reported in the literature (Ball, 2003; Higgins, Beauchamp & Miller, 2007; Smith, Hardman & Higgins, 2006; Woodrow, Mayer-Smith & Pedretti, 2000).

3. **Key Learning Areas** – The teacher mainly used the IWB for mathematics, English lessons and some science lessons, though the other participants advocate the value of the IWB across all curriculum areas. Indeed, most research has focused on Literacy and Numeracy contexts for IWB usage (for example, Shenton & Paget, 2007; Wall et al., 2005).

4. **Stages of learning** – Again the teacher differed in opinion about the effectiveness of the IWB as a resource across all age groups, saying that the IWB would be more appealing to younger students. Like Cartwright and Hammond (2007), the consultant made the point that the teaching approaches need to be matched to the developmental levels of the class.

5. **Learning needs** – It was generally felt that the diverse range of features and applications of the IWB offers opportunities to cater for students with particular learning needs, with the principal particularly interested in the potential for special needs children. Previous research has mainly reported on the visual affordances of the IWB (Fetherston, 2008) and on learning styles or multiple intelligences (McCoog, 2007), but little attention has been given to special needs students.

6. **Reactions of staff members, parents and students** – all participants agreed that the overall reaction of all people involved in the school community to the introduction and use of IWBs had been positive, with the initial reluctance of some teachers gradually overcome through professional development. Parents were found to be very enthusiastic and supportive of the purchase of more equipment. The majority of students also reacted favourably to IWB usage, finding the increased access to technology in their learning in accord with their contemporary expectations (Hall & Higgins, 2005).

7. **Impact of student behaviour, outcomes, motivation and interactivity** – strong consensus was apparent regarding the positive impact of the IWB on students. As found in other studies, the impact seems to be largely due to the enjoyment students gain from interacting with the IWB which results in increased time-on-task (Beeland, 2002; Goodison, 2002; Levy, 2002; Shenton & Paget, 2007).

Study 1 Conclusion

In this type of research it is not the role of the research to draw conclusions, nor attempt to generalize the findings, but rather to provide rich information that may have implications for further research or to initiate
theories about the phenomenon being studied. Although the three participants were affected by the interactive whiteboard differently due to their varying experiences and roles within education, collectively, five strong commonalities about the phenomenon were identified:

- There is a tendency for teachers to at first use teacher-centred approaches but to gradually change their IWB pedagogy to more child-centred approaches;
- The wide variety of features that the IWB offers means that it caters for a range of learning needs and different learning styles;
- If used effectively, the IWB has the potential to be a very powerful learning tool in the classroom and assist with planning and programming in the long term;
- The IWB engages and motivates students because of its interactive nature as students are always actively involved in their learning, in turn positively effecting classroom and behaviour management;
- In the future, educators would like to see the IWB used to its fullest potential and learn more about the emerging software and other peripherals that are being developed.

Study 2  Teacher Creativity  Researcher: Caddie Ruster

Research aim
This study explored a teacher's creativity with the IWB to understand a teacher's feelings, motivations, and the causes and effects of creativity, to enable us to understand change of pedagogy over time. Specifically, the study aimed to explore the following research questions:

- Does the IWB advance and develop teachers' creativity?
- Does teacher creativity with the IWB depend on external factors or can it merely develop on the teacher's own individual accord?
- Can a turning point in teaching creatively with the IWB be identified or is it a gradual process?

Theoretical considerations
Research on the use of IWBs in education has centred around three main dimensions; IWB uses in education as a new technology, IWBs in education as a tool, and the IWB's effect upon teaching practice in education. Various benefits of utilising the capabilities of IWB have been reported (For example: Ball, 2003; Beeland, 2002; Johnson, 2002; Kennnewell & Beauchamp, 2003; Miller, 2003). However, research has not yet explored whether these benefits result in a stimulation of teachers’ creativity when using IWBs in their classrooms. Such research may reveal the impact of IWBs' benefits on creativity within pedagogical practice.

Prior to the introduction of the IWB in the educational setting, researchers such as Halliwell (1993), Fryer and Collings (1991) and Craft (1997) wrote about creativity in the context of education. Craft (1997) identified several factors crucial for creativity to occur in teachers' professional development: a) relationships with various parties such as colleagues, b) personal autonomy, c) risk taking, d) receptiveness to various influences, e) valuing and admiring creative teaching that individual teachers want to achieve themselves, and f) nourishing the teacher. More recently, the reviews of research conducted by Loveless (2002, 2007) and Ashfield (2008) claim that the IWB provided opportunities for teachers to “design, create and employ digital resources that demand creativity in teaching…” (Wood & Ashfield, 2008, p. 94). They make the argument that creativity does not automatically occur due to the IWB’s software but that it is essential that teachers “fuse this technology with pedagogy” (Wood & Ashfield, 2008, p.95). A rare example of this fusion, and of central ‘moments’ in the development of IWB pedagogy is provided in the report of a teacher’s self-study by Hodge & Andersons (2007), which emphasised how individual and personal a teacher’s ‘journey’ is.

In this study teacher creativity refers to changes in a teacher's pedagogical reasoning skills (Shulman, 1987) and so relates to the development of teacher knowledge. Of particular interest are the changes that reflect “new and novel ways of thinking that break with previously established norms” (Bailin, 1994, cited in Lewis, 2005, p. 2). Underpinning this is the theoretical perspective of personal constructivism, which means the teacher constructs their own learning on an intra-personal level through their own initiatives and efforts. Therefore it is assumed that, by reflecting on their use of the IWB, the teacher is able to discover patterns of their creativity. As the creativity is likely to produce tangible results (in the form of IWB resources and teacher actions), this study takes into account both the processes and products of creativity (Tardif & Sternberg, 1988).
Methods
A biographical approach was employed with one teacher to allow for an intense exploration of an individual teacher’s evolving creative use of the IWB and its effects on teaching methods. A key criterion of the participant’s inclusion in this research was that the teacher must have an IWB permanently in his/her classroom, which they incorporate daily into their teaching. An oral history method was utilised in which the researcher engaged the participant in extended flexible interview to allow her to ‘tell her story’, in particular describing ‘turning points’ in the ways in which she thought about and used the IWB (Creswell, 1998; Denzin & Lincoln, 2003; Hesse-Biber & Leavy, 2006).

Analysis consisted of closely examining the interview transcriptions for indications of changes in attitude towards and uses of the IWB, for a turning point in creativity and for factors influencing the emergence of creativity. Interpretations of the teacher’s ‘story’ were sent to her for verification and clarification.

Results & Discussion
Careful reading of the interview transcript revealed four major themes in relation to creativity and the IWB:

a) The influence of training and external support – the major sources of new knowledge and skills had been self-teaching and observing other teachers;
b) Attitude and motivation – the teacher exhibited interest in the IWB’s capabilities and a willingness to explore them;
c) Achievements with the IWB – the three categories were found were daily routines, classroom management and modelling or demonstrating, with emphasis on the increasing use of web resources;
d) Opinions on development of creativity and professional learning with the IWB – the teacher viewed creativity in terms of the reaction and engagement of the class and believed the IWB was influencing her to become more creative in designing units of work.

When asked specifically about a turning point in creativity the teacher identified a lesson in which Google Earth was used to zoom in on a location, causing much excitement amongst the students. She believed that the IWB provides fresh ways of thinking and although she was pleased with her development so far, that her learning would continue because there would always be further developments with the IWB software. The teacher noted the importance of picking up new techniques from other teachers, and the need to find time to explore and develop these. She also highlighted the need to re-examine the content of each curriculum area and consider the specific application of IWB resources and tools.

As reflected in early research, the IWB’s features, such as its highlighting and touch screen capacity, can be beneficial as a tool in education (Ball, 2003; Higgins et al, 2007; Hodge & Andersons (2007). Within the teacher’s own conception of creativity, the IWB had led to change in pedagogy, though in most instances the teacher’s use of the IWB appeared to be simply replacing the blackboard. That is, - the IWB was a tool making conventional teaching patterns easier for the teacher (Gillen et al, 2007). However, when the teacher’s pedagogy did reflect ‘new and novel ways of thinking’, this was largely attributed to digital resources that became more accessible through the IWB, such as You Tube, television programs, music and Google Earth. Wood and Ashfield (2008) support this notion, claiming that such digital resources “demand creativity in teaching” (p. 94). Interestingly, the two instances described by the teacher that seem to be examples of pedagogical creativity, both involved a relationship between non-digital resources (a picture book and clay models) and the internet and software resources via the IWB.

Study 2 Conclusion
It was discovered that teacher creativity with the IWB depended on both external and internal factors - the teacher’s enthusiastic and pro-active attitude towards the IWB, and input about capacities that the IWB possesses. Although the teacher had undertaken some in-service training it became apparent that the teacher’s professional learning (and therefore creativity) was more influenced by the informal support of other teachers. The teacher clearly valued opportunities to see the IWB’s capacity put into action to teach specific Key Learning Area content, suggesting that professional development on generic skills with IWBs may not effectively impact on specific pedagogical content knowledge – a potential area of further research.

Furthermore research needs to specifically investigate how teachers’ creativity with the IWB can be cultivated for the long term as this ultimately will influence teachers’ pedagogy and their students learning. Much can be learnt from other teacher’s experiences and conversations of exploring, describing and examining teachers’ creativity with ICT.
Study 3: Interaction Patterns  Researcher: Elizabeth Lilley

Research aim
The study investigated the influence of different teaching styles, when using an Interactive Whiteboard (IWB) teaching tool in primary school classrooms, on the types of interaction that result during the lessons. It sought to produce an initial mapping of the dynamic relationships between the interactions of the teacher, the interactive whiteboard and the students. Four interactive whiteboard teaching methods were chosen: pre-prepared screens, interactive games/online resources, multi-modal texts, and blank canvas. The study was concerned with the patterns of five types of interactions: the use of teacher-to-student interactions, student-to-teacher interactions, student-to-other student interactions, student-to-IWB interactions, and teacher-to-IWB interactions.

Theoretical considerations
Recent research literature raises the question ‘is it the board that is interactive and/or does the way the teacher uses the board in their lesson influence the level of interactivity with the learning’? (Shenton & Pagett, 2007:130). Some researchers are of the opinion that if teachers use IWBs to present particular software programs on CD-ROM and Internet resources, lessons automatically become more interactive Shenton and Pagett (2007). In contrast, others argue that lesson interactivity is achieved not by what the board presents, but by the style and chosen teaching method in which the lesson is conducted (Chin, 2004; Kennewell, 2006; Knight, Pennant & Piggott, 2004). Beauchamp and Parkinson (2005) combine these two polarised views, believing the choice of information displayed, as well as the style in which the lesson is presented, play a combined role in the levels and types of interactivities used in the lesson, with potential to shift the classroom dynamics from one dominated by teacher control to a classroom promoting co-learning and interactivity (Beauchamp & Parkinson, 2005).

Knight, Pennant & Piggott (2004) highlight discrepancies in the meanings of ‘interactivity’ applied in IWB research. A distinction should be made between technical interactivity (between the user and the computer) and pedagogical interactivity of teaching (participation of students with teachers and their peers). Technical interactivity can motivate the repetitive practice of skills, and pedagogical interactivity stimulates reflection on learning and higher-order thinking (Kennewell et. al, 2007). Interactive teaching can be defined as “students contributions are encouraged, expected and extended” (Kennewell et. al, 2007:62), or as “engaging students, student practical and active involvement, collaborative activity, and conveying knowledge” (Wood & Ashfield, 2008:86). Both definitions imply a deep level of participation by students and a degree of student autonomy. Deeper interactivity and greater learner control is considered to be valuable for developing concepts and higher-order skills (Kennewell et. al, 2007).

The types of interactivity researched in this study include students’ interactivity with the teacher, the IWB, the lesson content, and their fellow students. For the purposes of this study, interactive learning is defined as present in lessons that include reciprocal opportunities for discussion between children, appropriate teacher guidance of language and skills, activities providing environments that are conducive to student participation, and an increase in the level of student autonomy.

Methods
An instrumental case study (Stake, 1995) was used, which allowed examination of the particular issue of the effect of IWB teaching methods on interaction patterns, within the specific context of one classroom. The classroom was a Year 5 (10-11 year-olds) group in an all-girls private school, where both the teacher and students had been using an IWB as a major teaching tool in their classrooms for two years. Two lessons were videoed and observed, with a prepared matrix applied to map both the sequence and frequency of interaction types in relation to the IWB methods being used. The teacher was interviewed before the lessons about the planning and expectations, and after the lessons, using the video as a reflection stimulus, with a focus on interactivity patterns. Three student focus group interviews were also conducted. One focus group consisted of students with high levels of interaction across the types, the second group consisted of students with moderate or more selective interactions, and the third group consisted of students with very low levels of interaction during the lessons. The purpose of the interviews, which began by the girls drawing a picture of an IWB lesson, was to collect data on the students’ perspectives of their own reactions to the IWB methods employed.

A categorical aggregation process (Stake, 1995) was applied to the descriptions of the lessons, lesson observation notes and interview transcripts, drawing together instances related to the pre-determined themes of the four IWB teaching methods and five interaction types. Identification of correspondence
between categories revealed patterns and relationships between teaching methods and interaction types. Any links between teaching methods, interaction types and student preferences were further interpreted in relation to existing literature.

**Results & Discussion**

The results showed teacher-to-student interactions were the most frequent interaction in every IWB teaching method except when using an interactive online game. Student-to-student interactions were more commonly seen when the IWB was used for online games or blank canvas teaching methods, which confirmed the teacher’s prediction that games encourage student discussion and peer teaching. Teacher-to-IWB interactions were higher than student-to-IWB interaction when teaching with blank canvas and pre-prepared screen methods. This was contrary to the teacher’s prediction that teacher-to-IWB use would be the least frequent interaction in all lessons, yet reflected the frequently stated student perspective that the teacher is given a greater opportunity to use the IWB than they are. The nature of blank canvas usage confirms criticisms by Wood and Ashfield (2008) and Knight et. al (2005) that teachers overuse the teaching practice of ‘come up and show us’ on the IWB, where students write on the IWB the same as they would a chalkboard. The practice often inhibits student-to-student discussion, as the interaction is teacher controlled.

Kennewell’s (2006) belief that teachers often use pre-prepared screens for superficial student participation, such as circling words, or dragging and dropping manipulation of items on the IWB, was confirmed by the lesson observations. The teacher described her purpose in lessons using pre-prepared screens as “the girls are writing and explaining on it...the same as an ordinary whiteboard”. Pre-prepared screens were used in three lessons, making them the most frequently used IWB teaching method that day, and in each lesson the way the IWB was used did not vary during the lesson. It was the same repetitive practice of skills, lacking the opportunity for real ‘interactivity’.

Of the students’ drawings and annotations about common IWB use in their classroom, seven showed the teacher at the front using the IWB while the pupils were passive observers, while only two drew a student at the front interacting with the IWB while the class were at their desks or on the floor observing. Similarly, in focus group discussions students said they prefer to use the IWB themselves, believing the teacher uses the IWB far more than they do. This view is in accord with the findings of Wall et. al (2005).

The teacher criticised the IWB believing it can “often remove collaborative learning”, yet it was not the fault of the IWB but rather of the way the teacher was choosing to use the board that influenced the level of collaborative learning taking place. Collaborative learning and student-to-student discussion were most prominent during the online game. During the blank canvas lesson where students completed maths problems in front of the class, far more peer discussion took place than in the pre-prepared spelling lesson, where each child was given the same repeated task of circling the sound in each word shown on the screen. IWBs should primarily be used as a resource to encourage interpretation of lesson content rather than displaying content, as well as promoting pupil-discussion rather than teacher dominated questioning (Beauchamp & Parkinson, 2005).

**Study 3 Conclusion**

The study revealed blank canvas and pre-prepared screen teaching encouraged teacher control of the lesson resulting in the lowest levels of student-to-IWB use and most frequent teacher-to-student interaction. Online games and multi-modal text teaching instead encouraged collaborative learning and student autonomy, with the highest student-to-student and student-to-IWB interactions.

A greater understanding of the interaction patterns in the learning environment of classrooms using an IWB is needed so that appropriate decisions can be made by teachers about effective teaching practice.

This study raised the need for further research regarding the relationships between teachers’ intended interactions, actual observed interactions and student perceptions of interactions. Also of interest are possible variations in relationships between modes of IWB use and the resulting interaction patterns across differing content or curriculum areas.
Study 4: Age and Attitude            Researcher: Sophie Joncho

Research aim
Prior research in the area of interactive whiteboards has raised many questions involving teacher attitudes, changing pedagogy and resistance to the implementation of the technology in the classroom. This study investigated the relationship between teachers’ ages and their dispositions towards using IWBS in their classrooms. Information from such research has implications for the design of appropriate professional development.

Theoretical considerations
Grainger & Tolhurst (2005) highlight the significant impact teacher attitudes have on their use of technology in the classroom, suggesting apprehension and lack of confidence often leads to ICT taking a backseat to traditional learning methods. Glover & Miller (2001 & 2003) developed a method for classifying teachers into three typologies according to their ability and acceptance regarding the integration of interactive whiteboards into classroom practice. Missioners are described as those who are changing their whole approach to the teaching process in order to wholly integrate the interactive whiteboard, and encourage other teachers. Tentatives are those teachers who are inhibited by a need for further training or by a fear of the time that may be necessary to become competent. They are described as using the equipment as a basic level and making no changes to their traditional teaching methods. The third group are identified as Luddites who are opposed to the use of interactive whiteboards despite having access to training and the equipment (Glover & Miller, 2001 & 2003). A key question arising from this research; How changeable are teachers’ attitudes?

The link between age and attitude is a recurrent, yet somewhat under-emphasised, theme in the literature. Grainger & Tolhurst (2005) posit that there are a significant number of factors that affect teachers’ perceptions of ICT, which subsequently impacts on their integration of technology in the classroom. They mainly addressed organisational factors, however the incidental references to age throughout their paper are significant, yet somewhat overlooked. Quotations from interviewees often refer to learning from younger members of staff, yet the age issue is rarely elaborated. Grainger and Miller (2003) and Herbert (2002) generalised the competence of the younger generation in the area of ICT, and the inability of older teachers to readily adopt new technologies. Herbert (2002) presents many reasons for older teachers being ‘technophobes’, including fear of damaging the hardware and the feeling that their professional skills are being denigrated. As age cannot be altered through any amount of professional development, it is important to explore what impact (if any) it has on teacher attitude towards interactive whiteboards.

This study draws on the work of Ajzen and Fishbein (1975) to separate the meaning of ‘attitude’ from beliefs, subjective norms, behavioural intention and behaviour, and defines attitude as “an accumulation of information about an object, person, situation or experience…a predisposition to act in a positive or negative way towards some object” (Littlejohn, 2002). This view of attitude is situated within social constructivism, focusing on the individual making personal meaning from socially shared perceptions (Salomon & Perkins 1998; Windschitl 2002).

Methods
In order to explore the relationships between typologies of teacher attitude towards interactive whiteboard technology and the teacher’s age, a qualitative case study research design (Stake, 1995) was employed as an organisational perspective. A school in Sydney's Northern Beaches suburban area with a staff of 17 teachers covering a wide age-range, was used as the case. Ten of the teachers agreed to complete a survey gathering background information, such as age and teaching experience, as well as data on the use of and attitudes towards technology. Analysis of the surveys lead to the identification of three teachers from three different age groups who exhibited interesting views in relation to the research question. These teachers were then interviewed to obtain further information.

A categorical aggregation process (Stake, 1995) was applied to the interview transcripts and questionnaires, drawing together instances related to the pre-determined themes of the three typologies of attitude and of teacher age. Data were classified into content categories and common and contrasting themes were identified. In addition, a more holistic open-ended analysis was carried out to allow the identification and description of other themes that emerged.
Results & Discussion

The ten questionnaires revealed three age groups – four teachers in the 18-28 years, four 29-38 and two 49-58. Although all the teachers had received training and had some experience in using an IWB, the frequency of current IWB usage ranged from ‘rarely’ to 10 hours a week. The majority of teachers expressed positive attitudes towards IWBs, however variation was found in the following aspects:

- One teacher in the 18-28 years age group expressed a positive initial feeling but a negative current feeling towards IWBs.
- One teacher in the 29-38 age group remained somewhat neutral/negative in both their initial and current feelings.
- One teacher in the 49-58 age group articulated a negative initial feeling but a positive current feeling.
- Two respondents in the 18-28 age group ranked the negative impact of the technology penalty as more significant than the benefit of using the IWB. All the other respondents rated the benefit above the penalty.

Although the questionnaires did not provide sufficiently detailed attitudinal data to conclusively align each teacher with one of Glover and Miller’s (2003) typologies, a loosely defined categorisation was possible. Interestingly, all three age-groups contained both a Luddite and a teacher showing at least some of the characteristics of a Missioner.

Several prominent themes emerged from the interviews with the three selected teachers:

- Contrasting views emerged on the contribution of age to attitude development. Whilst Participant D (18-28) communicated the idea that younger teachers are generally more technology savvy than their more mature colleagues, Participant J (49-58) stated that she did not believe her age affected her use of or attitude towards IWBs, claiming the IWB to be the most revolutionary piece of equipment she had seen in her teaching career, yet saying she needed to build skill levels (Tentative).
- The impact of IWBs on teaching styles varied greatly from Participant D (18-28) using hers for approximately one hour per week and essentially ‘uninterested’ (Luddite), to Participant E (29-38) changing her pedagogy to effectively integrate the IWB into her daily teaching (Missioner).
- Technical difficulties, inadequate training and the time consuming nature of the technologies emerged as the most prominent problems with using IWBs.
- Participant J (49-58) discussed the limitations of her own capabilities in relation to her use of the IWB, while Participant D (18-28) highlighted the problems directly associated with the technology.

Although the ‘age factor’ was raised by several of the participants as a possible issue, data from this study suggest that the major factors contributing to a negative attitude are technical difficulties, insufficient training and the time involved in developing skills and planning lessons. As these issues can affect any teacher of any age, it appears that age is not a contributing factor in this case, which contrasts with Herbert’s (2002) general view. It is interesting to note that, Participant E, who is considered a Missioner in Glover and Miller’s (2003) typologies, made reference to each of the three factors mentioned above during her interview. The difference being, she did not discuss them in a negative manner, rather she provided the solutions she had developed to deal with the problems.

The typologies developed by Glover and Miller (2003) to classify teachers according to their attitudes towards technology somewhat merge the aspects of attitude and current ability, making it difficult to classify teachers who exhibit transitional characteristics.

Study 4 Conclusion

The participants in the study were not consistent with the general view that older teachers are reluctant to interact with technology whilst young teachers are technologically savvy. It was found that age itself does not determine a teacher's attitude towards IWBs, rather it is their belief in the technology and its value. Much of the teachers’ learning occurred after the initial professional development sessions, when they’d had the opportunity to explore either by themselves or with colleagues. Thus, in-service courses should provide the foundations for this self-exploration, and avenues for reporting back or reflection should be created.

Whilst it is evident that a lack of skills in using the IWB does not necessarily impact on a teacher’s attitude, it would be interesting to investigate if age has an impact on skill acquisition.
Study 5  Visual-spatial Intelligence  Researcher: Lisa Ochs

**Research aim**
This study investigated the potential of the Interactive Whiteboard (IWB) to promote ‘spatial intelligence’. The aim was to explore students’ preferences for learning and examine whether visual preferences are promoted when features of the IWB such as animation, interaction and graphics (to name a few) are utilised.

**Theoretical considerations**
The concept of intelligence has changed to suit the needs of a society over time and in today's technology-oriented society, spatial intelligence is of particular importance and the traditionally favoured linguistic and logical-mathematical intelligences have become less dominant (Diezmann & Watters, 2000; Silverman, 2000). IWBs allow teachers to teach multi-sensory, multi-modal style lessons, seamlessly jumping from one type of digital media to another (Kent, 2004). This style of teaching and the IWB’s modern, quality presentation, satisfies the expectations of pupils already immersed in a world of media images (Glover and Miller, 2001: Beeland, 2002).

A number of researchers have noted the potential of the visual, auditory and tactile features of the IWB to accommodate a range of ‘intelligences’ in students (Glover & Miller, 2001; Beeland, 2002; Bell, 2002; Neil, 2005). In particular, the IWB’s visual capabilities and features provide teachers with the opportunity to assist students who best learn through visual stimulation, which aligns with spatial intelligence - one of the ‘Multiple Intelligences’ described by Gardner (1991). Spatial intelligence involves vision and spatial judgment. Spatial intelligence is the ability to think in pictures, learn visually and organize things spatially (Gardner, 1993). People with strong visual-spatial intelligence are typically very good at visualizing and mentally manipulating objects. They have a strong visual memory and are often artistically inclined. This intelligence involves sensitivity to colour, line, shape, form, space and the relationships that exist between these elements. It includes the capacity to visualise, to graphically represent visual or spatial ideas, and to orient oneself appropriately in a spatial matrix (Armstrong, 1994). Spatial intelligence also goes beyond the visual aspect of seeing images and includes abstract and analytical abilities (Gardner, 1993).

The benefit of IWB resources to students with visual-spatial learning preferences (Wall, Higgins & Smith, 2005) has been identified, as well as the potential of developing these visual media skills in other students (Neil, 2005). However, due to the relatively new introduction of the IWB to the classroom, research is yet to provide educators with a clear understanding of the impact of the IWB as a visual resource to promote students’ spatial aptitudes within the primary classroom. Such findings would facilitate teachers’ evaluations of whether IWBs were being employed effectively to nurture students’ ‘spatial intelligence’.

**Methods**
A phenomenological method was used as it sought to concentrate on phenomena as objects of perception in an attempt to examine the ways teachers and students think about and interpret the use of the IWB in the classroom. Using a qualitative method allowed for rich descriptions of complex phenomena and proved useful in developing a conceptual framework to explain those phenomena (Center for Organization, Leadership, and Management Research, 2008). Through this approach, knowledge claims were based primarily on constructivist perspectives (Creswell, 2003). A case study was the most practical approach to investigating the research question given the time restrictions. An inquiry of one particular case was also chosen for the purpose of gaining an in-depth understanding into the issue under scrutiny (Stake, 1995). Using the case study approach with a limited sample meant that a multi-method approach was best suited in order to gain sufficient data to compare, contrast and make substantiated conclusions. The multiple forms of data collected also enabled verification of responses and thus, enhanced the reliability of the data.

The case studied approach was one Stage 3 class of boys in which an IWB was commonly used as a lesson focus. Phase one of data collection consisted of a simple screening instrument to identify each student's dominant learning style/s, and a questionnaire to gather data about student perceptions of various ways in which features of the IWB were used in lessons (for example, graphics, sound, text, animations), and included a drawing of a favourite IWB activity. Comparison of the information from both data sources was used in the purposive sampling of several students for individual semi-structured interviews. Short semi-structured interviews with the teacher and one partial lesson observation served to clarify the features of the IWB generally being used in lessons and allow context description.
Results & Discussion
The Multiple Intelligences screening revealed a range of profiles of intelligences in the class, with Visual-spatial intelligence ranking the fourth strongest of the class totals. Just under half of the boys displayed very strong results of this intelligence. The results of the questionnaire showed that a number of boys (even those with low visual-spatial intelligence) strongly valued the visual features of the IWB. Such responses were further supported by the interviews where all boys indicated an appreciation for the clarity and flexibility of the IWB to provide a diversity of visual learning experiences. The teacher also emphasised her belief that IWBs are highly effective visual learning tools that assist in planning and delivering a variety of interesting lessons that have the potential to promote both learning and engagement.

The results indicated that the majority of students and the teacher had positive views towards the visual capabilities of the IWB. When comparing the data sources, it became evident that it was not only students with high Visual-Spatial intelligence who responded well to the visual capabilities of the IWB, but also other students with different profiles of intelligences. Trends also emerged, in the questionnaires and interviews, which suggested it was only when the IWB's features were used creatively and effectively that learning and engagement was promoted, highlighting the impact of teachers’ pedagogic approaches to implementing the IWB in lessons.

Similar to existing research (Neil, 2005; Beeland, 2002; McCoog, 2007), investigations of students’ attitudes to IWB use in the classroom, revealed that the visual features of the IWB were advantageous to learning and engagement. Findings highlighted students’ commendations of the clarity of text and images and the versatility of the IWB to produce a diversity of visual learning opportunities (eg. through films, scanned images, internet connection). Consistent to findings of other studies (Smith, Higgins, Wall, Miller, 2005) a number of students suggested, in the questionnaires and interviews, that they learnt more from lessons involving the IWB because new information was easier to understand and the visual display of information enhanced recall.

It is important to note that intelligences usually work together in complex ways (Armstrong, 1994). Whilst the data suggested the IWB’s visual assets were highly valued, a large number of students suggested IWBs assisted learning to become more interactive in terms of being able to react directly with the board, and with peers. This links with Bodily-Kinaesthetic and Interpersonal Intelligences, that were among the strongest in the class results of the Multiple Intelligence screening. Such results, in addition to the abundance of questionnaire and interview responses relating to these intelligence types, may be influenced by the gender of the participants. Boys need greater stimulation to engage the cerebral cortex (Nagel, 2006) and consequently, the preferred teaching methods for boys are active, hands-on and very visual (Evans & McDonald, 2007).

Study 5 Conclusion
The results of this study strongly suggest that effective exploitation of the visual capacities of the IWB have the capacity to promote visual-spatial intelligence in all students. The primary reason for this appears to be the facility to engage students in the IWB’s visual appeal and also to assist learning by means of developing various visual-spatial skills such as visual discrimination. This may be a fruitful area for further study. The fact that we live in an increasingly technology-oriented society, whereby people are progressively more exposed to a diversity of multimedia images which require deconstruction (Fetherston, 2008), provides a strong justification for that further study to be undertaken.

Effectively using this information, in conjunction with effective teacher training and development, has the potential to assist educators in their decisions to use IWBs in their efforts to reach all students in a diverse classroom.

It can also be concluded that the IWB’s effectiveness relies on teacher confidence, attitude and aptitude (Vincent, 2007; Lee & Winzenried, 2006; Glover & Miller, 2001) in order to promote visual learning. An area of further study could follow the path of what constitutes effective training in terms of the IWB and teacher pedagogy and technological skill development.
General Conclusions and Directions for Further Research

The final section of this paper considers the collective implications of the five studies in relation to existing literature about the pedagogy of utilising IWBs in primary classrooms, with particular emphasis on identifying important directions for further research. Although many educators remain sceptical about the value of IWB technology in the overall scheme of teaching and learning, it cannot be denied that the phenomenon of IWB-based teaching is having a significant impact in primary schools and will continue to build in momentum, probably until saturation is reached. An important point to realise is that studying IWB-influenced pedagogy is different to other general pedagogical studies because of the dominance the IWB has over the classroom environment. Once teachers begin to regularly use an IWB, there seems to be no turning back. As teachers realise the IWB's capacity to cater for a diversity of student learning needs, influence classroom behaviour management, increase student engagement, interaction and motivation, IWB usage becomes entrenched in daily practice (Mauric, 2008). Unlike other individual pieces of technology in the past, the convergence of a broad range of technologies in the IWB clearly has the power to make a major impact on pedagogy in primary classrooms and therefore urgently needs deeper research to inform effective professional learning for teachers, with the purpose of ensuring the best learning outcomes for students. As the functions of the IWB have been credited with improving classroom management (Lilley, 2008, Mauric, 2008; Ochs, 2008), it is apparent that outcomes for students should not only be measured by academic achievement but also in terms of motivation, engagement and generally productive behaviours.

1. Shifts in pedagogy

Much of the debate about the value of IWBs in classrooms centres on the question of whether they prompt a shift towards teacher-centred pedagogy or prompt student-centred pedagogy, with current interpretations of constructivist theories of learning favouring the latter. However, the danger of describing such general trends is that, because such uniformity in teaching style does not exist, the complexities of individual teachers and their classrooms can be overlooked. What of the teachers who use combinations of teaching approaches, or who already prefer teacher-centred whole-class lessons, or who use whole-class lessons in highly interactive ways? Few studies have established ‘before’ and ‘after’ pedagogies and tracked such changes over extended periods of time. It is not just the direction of the shift, but its magnitude and the complexities within the shift, that now need to be understood.

As suggested by Ruster (2008) a key to understanding changes in pedagogy over time may be to identify the development of creativity, particularly the turning point where a teacher’s attitude, confidence and skill allow him/her to take innovative control of the affordances of the IWB.

The interrelationships between several factors seem to be critical in shaping pedagogies:

- a) the affordances of the particular IWB feature,
- b) the content of the lesson;
- c) interaction patterns between the teacher, IWB and students, and
- d) the reactions of the students.

These interrelationships require careful exploration and theorising as they appear to be complex and perhaps to some extent causal. For example, regarding the relationships between affordances and interaction patterns, Lilley (2008) found that teaching with blank canvas and pre-prepared screen tools encouraged teacher control of the lesson resulting in the lowest levels of student-to-IWB use and most frequently involved teacher-to-student interaction. Whereas teaching with online games and multi-modal text instead encouraged collaborative learning and student autonomy, with the highest student-to-student and student-to-IWB interactions. There appears to be correlation between using features that most closely replicate other standard tools such as chalkboards or flip charts, and lower levels of student involvement and autonomy. However, lessons that make greater use of the more advanced affordances of the IWB appear to stimulate higher levels of student involvement. Ochs (2008) concluded that when a teacher matched effective pedagogy with the visual affordances of the IWB, that learning via visual-spatial intelligence was promoted in a broad range of students, not just those with strong visual-spatial preferences for learning, highlighting that the teacher’s pedagogical choices are critical in ‘activating’ the learning opportunities offered by the IWB functions.

A strong theme in the research findings is the positive reaction of students to IWB lessons, in terms of their motivation and engagement, though it is clear that the strength and nature of the reaction varies with the particular affordances and interaction patterns (Lilley, 2008; Mauric, 2008; Ochs, 2008; Ruster, 2008). For example, when ranking the features of the IWB, the class in one study rated ‘touching the screen’ and watching film clips the highest, and commented that they valued the increased pace of lessons, increased class discussions and the ‘learning from each other’ that occurred in some IWB lesson (Ochs, 2008).
Students are aware of the features in IWB lessons that support their learning. For example, in interviews Ochs (2008) found that some of the students elaborated on their preference for IWB activities by commenting on colour, movement and clarity of visual images that caught their attention and helped them remember things later. As teachers become more versatile with the IWBs functions they shape their pedagogy in response to the students’ reactions – their engagement and enjoyment – making deliberate decisions about the type of learning and interaction patterns they want to take place. For example, the teacher in Lilley's (2008) study planned teacher-to-student and student-to-teacher interactions in the lesson using ‘blank canvas’, as she wanted the students to ‘verbalise their thinking processes’. Similarly, the teacher in Ruster's (2008) study explained she was increasingly making use of quickly accessible web resources such as Google Earth, literature on the web, video footage, music and lyrics and You Tube, as well as using software packages such as ‘Animations’, largely because of the strong positive response from the class.

2. Content specific pedagogy
Much of the research has focused on teacher and student interactions with the IWB, however, as Kent (2004) points out, perhaps a more important aspect is the potential of the IWB to facilitate new ways of interacting with lesson content. Rather than using the IWB to display content, the affordances should support interpretation of the content and promote student-content and student-student interactions (Beauchamp & Parkinson, 2005; Mauric, 2008). Attention must also be given to interactions between IWB-based resources and other non-digital resources, as these interrelationships seem to inspire creative pedagogy (Ruster, 2008).

An emerging notion is that particular IWB affordances may be content specific and so the IWB may be used differently in different areas of learning such as mathematics, English or social studies (Mauric, 2008; Ruster, 2008). As many of the existing studies have been imbedded in Literacy and Numeracy contexts, little information has been gathered about the nature of these differences.

3. Professional learning and development
Perhaps the most stunning aspect of IWBs is how readily they have been adopted as a prominent teaching resource across a broad range of classroom contexts. However, it is not necessarily an easy or smooth path of professional learning for teachers of any age and without training, technical support and effective development of pedagogy, teachers can become discouraged and the benefits of IWB use are not maximised (Johnco, 2008; Mauric, 2008). The collection of studies reported here have highlighted the following points to be considered in the design of approaches to professional learning around the use IWBs in the primary classroom:

- Although introductory technical training is crucial, it must include understanding of the various affordances of particular IWB features as a basis for pedagogical considerations. For example, exploring the interaction and learning opportunities offered by the function of turning handwritten/drawn items into moveable objects;
- Motivation towards integrating the IWB with teaching practice is related to attitudes rather than age;
- Knowledge of the learning preferences and special needs of the students can be used purposively to select appropriate IWB features and to design effective lessons (Ochs, 2008; Ruster, 2008);
- The visual affordances of the IWB have a particularly strong impact on most students and so have great potential in learning experiences (Ochs, 2008);
- Interaction patterns, in particular student-IWB and student-student interactions have strong impact on lesson dynamics and effectiveness of learning. Teachers need to be aware that using different features of the IWB can prompt particular interaction patterns and plan lessons accordingly. A dominance of teacher-centred interaction patterns may not maximise student engagement with lesson content (Lilley, 2008);
- Ongoing support for skill development and reflection on pedagogy are needed for many teachers to be able to move beyond limited use of the IWBs affordances into a zone of creative and productive pedagogy. Collaboration and sharing of ideas with other teachers about specific lesson content seems to be particularly important (Johnco, 2008; Ruster, 2008);
- Consideration needs to be given to age/stage appropriate approaches to IWB usage. While ‘taking turns to touch the IWB’ might be effective during the first few years of school, older students need to interact more deeply with the content and make more sophisticated use of the technologic affordances with increasing autonomy (Mauric, 2008). A mapping of age appropriate IWB strategies would be a very useful resource to develop for teachers.

Further questions arising from the symposium discussion ………..
References


