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Publication Details

Verenikina, I., Wrona, K., Jones, P. T. & Kervin, L. K. (2010). Interactive whiteboards: interactivity, activity and literacy teaching. In J. Herrington & B. Hunter (Eds.), Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications (pp. 2605-2614). VA, USA: AACE.

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Interactive Whiteboards: Interactivity, Activity and Literacy Teaching

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Abstract: This paper explores the implementation and the use of the Interactive Whiteboard (IWB) in literacy teaching in an Australian primary school. A socio-cultural approach (Vygotsky, 1978) and Activity Theory (Engestrom, 2001) are used to explore the integration of the IWB in the literacy classroom environment where the individual, classroom and the whole school contexts are considered. A socio-cultural conceptualisation of technology allows us to view the IWB as a tool that can be used to enhance teachers' pedagogical practices. The paper is based on a case study in an independent primary school located in a South - Western suburb of Sydney.

Introduction

Over the last thirty years researchers have been investigating the role that digital learning technology has on traditional teaching practice and student learning (Stevenson, 2007; Kennewell & Beauchamp, 2007). This paper aims to explore how interactive learning technology, namely the Interactive Whiteboard (IWB), contributes to K-6 Literacy teaching. It addresses two themes central to the literature surrounding interactive technology: interactivity and student motivation or engagement. Activity Theory (Engestrom, 2001) is used to explore the integration of IWBs in the classroom environment where the individual, classroom and whole school contexts are considered. At the individual level, the IWB is analysed as a teaching tool that can enhance (or hinder) the teacher's pedagogical goals. At the classroom level, internal tensions that occur when an IWB is embedded into an existing Activity System of a Year 3 classroom are analysed. The consideration of whole school levels of IWB implementation allowed us to examine factors such as school ICT policies, teacher professional development and collaboration.

Interactivity

One major theme in studying IWBs is their potential to change pedagogy through interactivity and to foster a more interactive style of teaching (Moss, Jewitt, Levačić et al., 2007). However, we wonder whether this is indeed possible as we examine the nature of the technology and scope of pedagogical practice.

The British Educational Communications and Technology Agency defines an IWB as "a large, touch-sensitive board which is connected to a digital projector and a computer…the computer can then be controlled by touching the board, either directly or with a special pen" (BECTA, in Hall & Higgins, 2005, p.104). The literature addressing interactivity often focuses on how this feature can enhance students' learning (Schuck & Kearney, 2007; NSW DET, 1998). However, such claims might be problematic given that interactivity has not yet been operationally defined (Hall & Higgins, 2005; Roussou, Oliver & Slater, 2008).

Higgins, Beauchamp and Miller (2007) argue that there is a substantial difference between the technological interactivity afforded by the IWB, and the pedagogical interactivity afforded by the mediating properties of the IWB and further, that technological interactivity does not necessarily transfer 1:1 into pedagogical interactivity.

Simply embedding IWB technology does not guarantee that it will be used interactively regardless of the degree of technical competence a teacher possesses (Gibson, 2001).

Beauchamp and Parkinson (2005) note that the processes by which teachers develop interactive practices are extremely complex. Moss and colleagues (2007) looked at the ways that IWBs act as a catalyst for the development of interactive pedagogy. The interactive uses of the technology that they observed are categorized as follows:

- Technical interactivity, where the focus is on interacting with technological facilities of the board;
- Physical interactivity, where the focus is on 'going up to the front' and manipulating elements on the board;
- Conceptual interactivity, where the focus is on interacting with, exploring and constructing curriculum concepts and ideas (interaction between students to co-construct knowledge) (Moss et al., 2007, p.40).

It is important that pedagogical interactivity, that is, the nature of interaction between the teacher and the students, which is essential for students' learning (Vygotsky, 1978), is discussed. It has been demonstrated that technological interactivity may result in higher incidences of teacher-centred learning given there is less teacher interaction with students and more teacher interaction with the technology (Higgins, Beauchamp & Miller, 2007). On the other hand, Schuck and Kearney (2007) suggest that IWB technology can facilitate a shift towards the student-centred end of the continuum as the technology becomes embedded in classroom activities. However, in light of current thinking about the dynamic nature of teachers' interactive strategies, the discussion must move beyond a simplistic teacher-centred/learner-centred dichotomy. How and when teachers use the IWB would largely depend on their pedagogical aims and their consequent choices of relevant software rather than the technology itself (Moss et al, 2007).

IWBs in teaching and learning

There is a steady trend emerging whereby the inclusion of interactive learning technology is considered to be an essential component to a world class education (Cope & Ward, 2002; Lee & Gaffney, 2008). However, a recent statistical study of the relationship between IWB installation levels and pupil performance conducted by Moss and colleagues (2007), "failed to find any evidence that the increase in the installation of interactive whiteboards (IWBs) in London schools has increased pupil performance in Key Stage tests" (Moss et al., 2007, p.72). This is interesting given that an increase in technology and associated budgets is often promoted as a way to boost student achievement.

Glover and Miller (2001) suggest that IWBs can considerably improve student motivation during the early stages of use, however, whether IWBs can enhance student motivation over sustained periods is uncertain. A number of studies report that students initially welcome IWB technology with enthusiasm and curiosity, which gradually wanes as the novelty wears off (Higgins et al, 2007; Tanner, Jones, Kennewell & Beauchamp, 2005; Beauchamp & Parkinson, 2005). Thus, undoubtedly the IWB is effective in gaining initial student attention, however, with reference to long-term motivation, the research tends to reassert the central role of the teacher in engaging students with lesson content and in fostering deep knowledge (Robertson, 2007).

It is important to differentiate that increased motivation in learning with technology does not necessarily mean that motivation is directed towards instructional content; i.e. the attention could be directed at the technology. For instance, Beauchamp and Parkinson (2005) suggest that the novel nature of IWB technology makes it attractive for students; that is, they perceive it as more exciting than traditional classroom tools (e.g. whiteboard or overhead projector). On the other hand, it has been found that motivation and attainment is higher in students who have an internal criterion for success. That is, if students have not yet developed the cognitive skills to recognise what counts as successful accomplishment, it is doubtful that technology will compensate for this. Thus, the technology may have little benefit to learning beyond that of an external reinforcer.

Literature suggests that technology alone is an unlikely panacea to students' attainment of curriculum goals (Gibson, 2001), as it "is always mediated by other experiences" (Zevenbergen & Lerman, 2007, p.861). The discussion of the role of the IWB in students' achievements urges to re-examine the classroom as a teaching and learning environment, and to examine closely how technology interacts with pedagogy in different classrooms.

Activity theory perspective

Activity Theory "has become an influential tool for the analysis and transformation of practices" (Martin & Peim, 2009, p.131). It is increasingly being used in educational research as a well regarded framework to explore the complexity of the educational setting at a point of change (Scanlon & Issroff, 2005; Lim & Hang,

2003). An "Activity Theory augmented view of evaluation" (Scanlon & Issroff, 2005, p.430) allows researchers to explore the mediating role of tools within an Activity System, without depending on participant's retrospective explanations of what they are doing, thus providing an analytical lens to complement the interview data (Hashim & Jones, 2007).

From an Activity Theory perspective a teacher in the literacy classroom is a *subject* of a complex activity system which is situated within everyday practice and includes a number of interdependent elements (Figure 1).

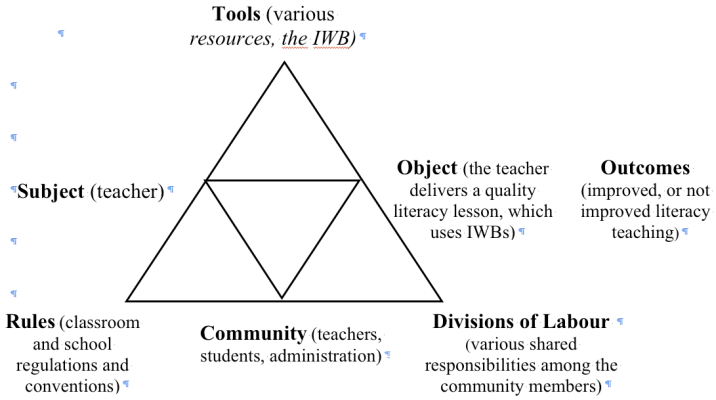

Figure 1. Activity System structure for a literacy teacher

Within the activity system, the IWB is considered as a pedagogical *tool* which is used by the teacher to achieve the goal of the activity (*the object*), i.e. teaching literacy. Thus, the teacher (subject) purposefully uses IWB technology as a tool to achieve his or her pedagogical goal and to incorporate the IWB into the activity in a sustainable and pedagogically sound manner. Such conceptualisation of the IWB as a teaching tool is important as it urges for a re-examination of the notion of interactivity and a discussion of how it is best viewed in relation to the IWB. Should it be viewed as an attribute of the technology, or as an interaction between the student and the technology? Or does it belong to teachers' pedagogy and their interpretation of curricula? If we accept the "tools' based philosophy of technology" (Verenikina & Gould, 1998), the latter is the most productive, as it is the teacher who orchestrates the classroom learning environment by making everyday decisions on pedagogically appropriate interaction arrangements (for example, small group work and teacher or peer scaffolding).

The way that the teacher organises the classroom is influenced by other people (*community*) such as school students and staff, including teachers, school executives and technical and administrative support. The relationships between these groups of people are regulated by *rules* within the activity. Rules can be implicit, for example, normative practices, expectations, social standards, or simply the way things are done, or explicit, for example, syllabi content (Liaw, Huang & Chen, 2007) or government documents (Commonwealth of Australia, 2009). Rules can be either malleable or fixed, and are often a source of tension as they can afford, or constrain what is allowed within the Activity System (Hashim & Jones, 2007). The *division of labour* relates to the distribution of tasks within the Activity System; namely, who from the community does what.

Activity theory explores the transformative processes that occur when people engage in interactions which are mediated by cultural tools (Rizzo, 2003). A common outcome of this process is the occurrence of tensions within, or between the elements that make up the System. The analysis of tensions offers researchers the opportunity to explore potential barriers (Zevenbergen & Lerman, 2007) such as those anticipated to occur when IWB technology is introduced to literacy teaching. Additionally, and importantly, tensions are often referred to as the driving force of change within an Activity System. Thus, Activity Theory offers for this study a discourse to explore the issues driving the tensions, and to comment on possible recommendations (Roth, 2004).

The Study

This paper presents part of a larger study of the use of digital technologies in teaching literacy. It aims to explore the ways that a teacher in one case study uses the IWB to mediate the literacy learning experiences of her students in a primary classroom. Activity theory is used as a framework to gain insight regarding the internal tensions that occur when a new tool is introduced to an existing activity system (literacy teaching).

Participants and background

This paper reflects data collected from an independent primary school in metropolitan New South Wales, Australia. The school is situated in a small community and includes around 600 students. This school was recommended for the research by regional administration as it displayed a regular and integrated use of computer-based technologies in all classroom programs as a learning priority, which included considerable financial commitments toward the purchase and maintenance of computer technology throughout the school. The case of one teacher, Mary (pseudonym is used), a late career Year 3 teacher, is presented in this article by examining the ways she incorporated IWB technology into her classroom literacy experiences.

Supported by a Federal Government grant, access to technology was at the forefront of the school priorities. Apart from IWB (Smartboard software 9.7), the classrooms were equipped with laptops, desktop computers and a data projector. Rooms were transformed to combine four classrooms in a large teaching space equipped with the digital technologies. Teachers at the school received some professional development and were supported through leadership personnel to share ideas and teaching approaches in an effort to successfully integrate the technologies into daily learning experiences for their students. There was a clear expectation that all teachers used available technologies regularly across all curriculum areas. The teaching of literacy is consistent in primary school, with all teachers conducting a regular literacy session which is the basis for this study.

The aim and research questions

The aim of this study was to better understand the use of the interactive whiteboard in literacy teaching from the perspective of Activity Theory. In particular, we consider the following questions: What are the issues surrounding the implementation and use of interactive whiteboards in literacy classrooms? What pedagogical ideas influence the use of the interactive whiteboard in literacy teaching?

The methods of data collection

Data collection techniques such as interviews with the teacher and school administration, video and audio taped classroom observations and document analysis were employed to form individual teacher case studies. Even though children were not the focus for the study, their parents and guardians were informed of the research and provided their consent. The researchers visited the site on multiple occasions (beginning in week 3 of the first term of the school year) and through this process were able to capture 'snapshots' of literacy practice, four of which, that encapsulated IWB technology, are presented below.

The data snap shots

Snapshot 1: Retelling using animation footage from YouTube

During this 60 minute period of observation, the use of the IWB as a group teaching tool in the open learning spaces was evident. Mary and two other teachers and their classes came together in the shared classroom space for the duration of the snapshot. The IWB occupied 'centre-stage' and the 90 students from the three classes were seated on the carpet with a clear view of the screen.

This teaching and learning episode was observed to proceed in three main phases:

- Review of what students know about the recount text type.
- Viewing of animation.
- A jointly constructed oral retelling of the animation.

The use of space observed in this classroom episode appeared very similar to that in a more traditional lesson using a chalkboard or whiteboard. The difference seemed to be that students' attention remained more firmly focussed on the IWB. The clear visual display and open space allowed students to have access to the technology and animation content. The use of space during the episode remained constant – the attention focus changed from being on Mary to the IWB and then jointly to Mary and the IWB as the key events were scribed.

The YouTube animation "Bernard the bear: The desert island" was used as a stimulus for children to practise retelling events in sequence – a key feature of recount text types. The three classes were engaged and focused on the animation. The visual text provided the students with opportunities to:

- Engage with visual and sound modalities to create meaning.
- Share meanings and knowledge through the reconstruction of the story.
- Become more familiar with the text as they were able to practise and rehearse the sequencing of events through multiple viewings.

Snapshot 2: Sentence Building (with parts of speech) incorporating software and Interactive Whiteboard
In this classroom episode, the IWB was observed to be one of a range of 30 minute activities planned for the literacy session. This episode of using the IWB too moved through distinct phases:

- Explaining the activities for the session.
- First small group activity.
- Rotation to a second small group activity.

In the first stage Mary was observed to explain each of the tasks to the 90 students. Then students moved into their small group activities – most into the other three classrooms with those teachers and parent helpers. The observation focus was on the group of twelve students who remained with Mary at the IWB in the shared learning space, as they engaged with a software, 'Silly Sentence Machine' (available at that time on the Web at www.pbskids.org). Mary's instructional goal here was to ensure the children could recognise parts of a sentence and use traditional grammar labels such as noun, verb and adjective to label these. This activity moved through three distinct phases: an orientation in which the IWB was used to focus the students' attention and introduce the content; a second phase in which students were introduced to and encouraged to use the more technical terms for parts of speech and a brief final phase where students practised applying this technical terminology to the original IWB game.

The 'Silly Sentence Machine' game and the technological/physical interactivity provided the students with opportunities to: 1) actively and physically participate in creating sentences; 2) make connections between images and words (i.e. visual image accompanies each word or phrase); 3) practice constructing sentences through the repetition of the game. However, the 'Silly Sentence Machine' software did present some limitations to the experience: the labelling of who/how/type/what/where within the sentence structure was not consistent with language of the NSW K-6 English Syllabus (BOS NSW, 1998); for example, the use of the probe 'how' for the verb rather than adverb was potentially confusing.

Snapshot 3: Combining Simple Sentence (complex/compound sentences) incorporating software and Interactive Whiteboard
Mary again led the literacy session which seemed a smooth collaborative effort among teachers, and moved through distinct phases:

- Explaining the activities for the session (8 minutes).
- First small group activity (30 minutes).
- Rotation to a second small group activity (30 minutes).

The observation was focussed on a small group activity which initially backgrounded the IWB to the teacher's enactment of a short scenario. The second phase of the episode was a joint construction of sentences as Mary wrote children's descriptions of this scenario onto the IWB as children contributed ideas. Mary identified the verbs and then drew children's attention to which sentences had two verbs. The children then identified conjunctions. The use of the IWB to construct a handwritten text appeared to be an effective strategy which used a number of meaning-making tools in the service of the teacher's aims, particularly when coupled with the dramatisation.

The technological and physical interactivity of the IWB in the 'Spelling and Grammar – Language Structure' (BBC, n/d) game appeared to be well received by the students. It provided the students with opportunities to: 1) build meaning and knowledge through images, symbols, interactions and sound, not just words; 2) practice adding conjunctions to sentences through repeating the game.
However, the software was limiting to the experience in two ways:

- The software and the IWB only allowed for one child to interact with the software at a time, the other children observed. In addition, while the game appeared to be a motivator at the beginning of the experience, some of the students did appear to become distracted part way through the experience.
- The rigid yes/no structure of the software did not allow for contextual differences in grammar. In the observed episode children had difficulties to locate the 'correct' conjunction. In the first two attempts both children selected 'although', the software indicated that 'but' was the correct answer. Our analysis of this sentence within the software indicates that either option would be correct within our Australian context.

Snapshot 4: Making Sentences (punctuation) incorporating software and Interactive Whiteboard
The phases of the 35 minute session observed were more extended to that observed in earlier snapshots, involving a whole-group explanation of punctuation conventions and whole-group guided work at the IWB, an independent activity using children's exercise books, and whole-group sharing. Once again, the clear visuals of

the IWB provided all students with access to the technology and lesson content. The children in the group appeared to be on-task during the 'active', editing parts of this episode.

The 'Making Sentences' game (BBC, n/d) provided the students with opportunities to:

- Actively and physically participate in adding punctuation to sentences (one at a time).
- Practice punctuating sentences through repetition of the game.

The control of the software in this experience was with the teacher. Although it may have been necessary for the technology to be teacher-controlled, due to time or the fact that it was operated through a personal laptop, this was seen to cause some minor difficulties (i.e. a student trying to explain which part of the text she wanted edited – "at the end?" "No, right at the top").

Overall, Mary's inclusion of technology within the literacy experiences followed a pattern of predictability over the four observation sessions. The IWB and associated software, was used to engage and direct their attention to the specific literacy skills under focus and to inject an element of 'fun' to the practice of those skills. To this end, Mary's pedagogical style when using the technology, weighted more heavily towards the one-way teacher – centred approach. However, overall Mary's degree of control undulated across the phases of each activity, shaped by her pedagogic choices (which include the use of tools) and depending on the requirements and difficulty level of the specific literacy phase (Gibson, 2001).

Discussion

The literacy teaching experience is influenced by numerous contexts fundamental in shaping the Activity System explored in this paper. For instance, the literacy content of the NSW K-6 English Syllabus (BOS NSW, 1998) embodies the cultural and historical views that reflect normative literacy practices within Australia. In the Activity System, the syllabus scope and sequence constitutes the rules that govern acceptable literacy content, and to a certain extent, how classroom literacy is practiced. Although the syllabus is a standardised and mandated document, individual schools are responsible for creating programs of work or pathways for study which enable students to acquire literacy skills in sequence with learning outcomes. Thus, whether literacy practices include technology depends on factors ranging from resource availability, familiarity with technology, perceived value of technology, fit between technology and learning outcomes, and preferred teaching style (Zevenbergen & Lerman, 2007; Stevenson, 2005; Karasavvidis, 2009).

Pedagogically, the syllabus does not explicitly require teachers employ interactive practices, however, a considerable amount of emphasis is placed on talking and listening as well as the sequence of guided, shared and independent reading (BOS NSW, 1998). Thus, it could be argued that the rules imbedded into the curriculum anticipate a specific type of pedagogy based in teacher-student interactions.

In the snapshot one of the study, Mary's selection of teaching strategies when using the technology to instruct literacy learning were influences by a number of factors. While providing for a variety of students' experiences, Mary's use of the IWB was more in line with a teacher-centred pedagogy, i.e. the tool was used to broadcast an animation with the aim of exposing students to the components that make up a recount. This is similar to the findings reported by some other authors (Bennett & Lockyer, 2008). Mary's decision to use technology in this manner may reflect both her expertise as a skilled practitioner, and possible fears as an amateur user of technology. As pointed out by Kervin and Jones (2009), "Teachers are experts in pedagogy, not necessarily technology" (p. 1), and their initial applications of technology often correlate with their comfort zone; and the broadcasting an animation was a familiar activity for Mary. On the other hand, she was enthusiastic about using the IWB and described this as a good opportunity to link her teaching literacy to technology.

On a similar note, in snapshot two, Mary used the IWB with interactive software to construct 'Silly Sentences' with the aim of increasing the students' awareness about the parts of speech. However, in this session the technology, rather than the teaching experience, was interactive. To delineate, the software allowed the students to approach the board and participate in the activity, albeit only one at a time. Thus, the use of the IWB during this activity reflects Higgins, Beauchamp and Miller's (2007) concern that interactive technology will not guarantee interactive teaching at the student-centred end of the continuum. Additionally, this example raises concerns regarding the degree of interactivity afforded by supposedly interactive software. Nevertheless, it should be pointed out that Mary's choice to use the IWB during this session reflects one part of a larger lesson goal. As previously mentioned this included the use of interactive technology to identify the parts of speech, and to foster positive student attitudes towards learning literacy. To this end, the 'silly sentences' software was successful; i.e. it was suitably geared towards lower order skills, which ensured the students experienced success and developed positive attitudes. However, the second part to this lesson required students to engage in higher

order thinking. During this phase the IWB was not used, instead the students and Mary formed a small circle, and using physical cards, examined more complex parts of speech which was not afforded by the interactive software. Interestingly, although the tool in this phase changed from the IWB to a static card, the teaching style was more interactive; i.e. the formation of the small circle allowed both Mary and the students to purposefully interact. Again, this observation resonates with Higgins, Beauchamp and Miller's (2007) suggestion that teaching which limits the use of interactive technology may in fact be more interactive.

Object – tool tension

Mary's decisions on the use the IWB exposes the tension between technology, pedagogy, and the syllabus. Mary's teaching skills and experience allowed her to navigate this tension by shifting between teaching styles in order to make meaningful and practical connections between technology and literacy outcomes. Mary appeared to use the technology as an introductory vehicle, which was effective in engaging students before activities requiring higher order skills were introduced (Glover & Miller, 2001). In this case the technology had limitations regarding its ability to meet the syllabus outcomes beyond those tasks that required students to name and identify the parts of speech. That is, the activity afforded by the interactive software lacked a meaningful context and if Mary continued its use it could have reduced and limited the quality of learning opportunities (Zevenbergen & Lerman, 2007). Therefore, further inclusion of the IWB technology could add little to the lesson objective, thus, warranting little rationale for its continued use. This alters the still existing assumption that increased time spent using interactive technology will improve student learning, and that all technology is good, if not better than traditional teaching tools (Scanlon & Issroff, 2005; Robertson, 2008). Saturating education with digital technology will not guarantee that the tool will contribute to productive practice (Tanner et al., 2005).

Activity - tool tension

The introduction of a new tool can modify the Activity System, but this does not automatically mean that the new system will be an improvement on the existing one (Kaptelinin, 2006). How a tool is received by the Activity System depends on the perceptions of those that use it (Kennewell & Beauchamp). That is, the teachers as subjects are particularly influential in transforming the Activity System of their teaching through the beliefs and biases they hold about the value of technology. "To a large extent the kinds of changes the technology fosters depend on what teachers think it is for" (Moss et al, 2007, p. 6). Thus, if IWB technology is to be used to transform current practices, teachers will need sufficient training and ongoing support to address any negative beliefs, biases or misconceptions held about the value of technology as it relates to practice (Robertson, 2007).

In relation to the current study, this feature was noted through interviews with the school's leadership team. The team fostered a culture, which highly valued technology, and openly encouraged teachers to explore its use within their classrooms. However, this school's unique history is not necessarily a universal experience of teachers. For instance, the embedding of technology in pedagogy may be negatively viewed by some educators as they perceive it to devalue their role and expertise (Tanner et al, 2005). Comments from Glover and Miller's (2001) research support this with their suggestion some teachers feel that with the introduction of interactive technology they are making media rather than resources. To reiterate, the unsupported embedding of interactive technology will not guarantee that the technology will be influential in transforming the System; rather it is likely that the technology will be absorbed into existing practices (Kervin & Jones, 2009).

Subject - tool tension

In snapshot two Mary used the technology to build student confidence, before addressing more challenging concepts. Mary structured the activities hierarchically, whereby difficult content that required higher order skills occurred after content that employed lower order skills. Thus, rather than transforming her practice, the technology supported and strengthened Mary's existing skills. Conversely snapshot three illustrates the IWB being used to reinforce the traditional teaching practice of whole class instruction (Higgins et al., 2007) where Mary positioned herself at the front and side of the IWB facing the students. That is, Mary was positioned in a familiar pedagogical stance enabling her to watch over and orchestrate classroom activities.

Largely, the IWB was used not unlike a traditional whiteboard, which illustrates Rizzo's (2003) suggestion that technology integration has typically been used "to 'bolt-on' technology to conventional teaching practices" (Rizzo, 2003, p. 2) However, in each of Mary's sessions the IWB was used as part of a larger lesson plan. That is, the next phase saw the IWB being used to explore parts of text, namely, conjunctions through the use of interactive software. Thus, although the contents from the initial part of the lesson could have been covered on a traditional whiteboard, completing the lesson in the same space made logistical sense. This demonstrates that educators use technology for purposes that fit best with their plans (Zevenbergen & Lerman, 2007), i.e. in this case the technology was possibly being used both as a classroom management device and educational resource.

An additional tension that relates to the subject and tool is the fit between the tools' function as the designer intends, and the tools' function as the teacher intends. For instance, Scanlon and Issroff (2005) argue that given the belief that technology integration supposedly enhances teaching and learning, tensions between the creators and evaluators, and subjects or users of technology would be likely. In the current study, this tension was observed through the lack of fit between what the technology could do, and what Mary wanted to achieve in the lesson. For example, the IWB was not particularly useful for tasks that required higher order thinking. Thus, when Mary's lesson shifted to include more difficult content, the technology had no further role. Mary's choice to mix resources and strategies reflects her experience and expertise as an educator, and teachers should, indeed, be acknowledged for their pedagogical rather than technological expertise (Kervin & Jones, 2009). However, by this same logic developers of hardware and software are recognised for their expertise, which does not necessarily relate to teaching and learning. Thus highlighting a tension between the object of the teacher, which is to enhance student literacy skills with the use of technology, and the object of the technology developer, which is to make a marketable product. For instance, in snapshot three the 'Language Structure' software developed by the BBC did not marry up with Australian vernacular, specifically, the task required students to select the correct conjunction. During this activity two students selected the conjunction 'although', but the software indicated that 'but', was the correct answer; within the Australian context either option would be suitable. Again, this illustrates the tension between the software developer, subject and object. That is, the rigid software rules can frustrate the subject as they do not correspond with the literacy objective as defined by the rules, i.e. syllabus.

Subject - rules tension

Although the appropriateness of interactive technology as a pedagogical device rests with the teacher, teachers may feel that using the existing resources included with the product is more practical than developing new ones, given their existing workload, or lack of familiarity with technology (Glover & Miller, 2001). However, the fit between the technology developers' objectives and teachers' objectives is not always comfortable. To be effective users of technology, teachers need time to develop their skills whilst realising they feel valued and "…acknowledged for the considerable knowledge that they have about their profession" (Kervin & Jones, 2009, p. 2). If technology is to be used as a purposeful pedagogical device, teachers or the teaching community should have input about the impact this will have on their profession. To this end, Donald Norman (1993, in Kaptelinin, 2006) cites "Grudin's Law" which reads, "When those who benefit are not those who do the work, then the technology is likely to fail" (p. 59). Thus, technology integration needs to find a balance between supporting the professional expertise of the teachers, whilst ensuring teachers maintain or retain control of the means of production. That is, to be successful technology needs not only to enhance student learning, but increase job satisfaction, or at the very least not disenfranchise or alienate teachers.

Community - division of labour tension

A tension that resides at the centre of interactivity relates to the division of labour. The division of labour regulates the distribution of tasks within the community (Liaw et al., 2007). In the current study the community comprises of the classroom teacher and students who work together to achieve an outcome, i.e. deeper literacy knowledge. Issues relating to the division of labour were observed in snapshot four. During this session the IWB was used to enhance the students understanding about sentence structure through the use of the 'Making Sentences' software (BBC, n/d). During this activity control of the technology was with Mary, which signalled a hierarchical separation between the teacher and students (Liaw et al., 2007). As already indicated, the reasons for this may have been due to the limited timing of our observation, time restrictions, or the fact that some of the technology was Mary's property. Nevertheless, Furlong et al. (cited in Hall & Higgins, 2005) report that student access to interactive technology is often limited and prescriptive. Thus, in this session for pragmatic reasons access to interactive technology was limited, i.e. only one student at a time could access the board, albeit the other students could watch. Thus, the division of labour is influenced by not only pragmatics such as time constrains, ownership of resource, and the rules that govern the technology, but also by the teacher's view about the value of technology as a vehicle to enhance learning. As a result, contact with technology involves an equity issue that divides who in the community has access to which resources (Hall & Higgins, 2005). For instance, research conducted by Beeland (2005, cited in Higgins et al., 2007) reports that students' views about IWBs are more positive when the applications make less use of interactivity and the most use of presentational multimedia. Evidence to support this was observed in snapshot one, where the IWB was employed to present an animation. Conversely, in snapshot two the division of labour saw students engage with the IWB through taking turns to touch the board as part of a sentence building game. During this activity Mary's role was still dominant, in that she regulated who accessed the technology by calling forward individual students to participate.

The fact that only one student could use the technology at a time was largely due to the explicit rules built into the software. Thus, the rules regarding interactive technology raise questions about whether we can expect the technology mediate interactivity and what impacts might this have on the division of labour within the Activity System. That is, the explicit rules relating to technology, ideally should not limit how many participants can access the technology at a time. In other words, inherent rules that divide the community's access to technology paradoxically forfeit their mediational properties.

Conclusion

To conclude, this project has explored how interactive learning technology represented in the IWB mediates literacy teaching from the perspective of an Activity System. The results suggest that technology alone is not the remedy to a quality education system rather that technology is useful relative to its need in achieving a learning outcome. This paper has re-examined the importance of pedagogy by arguing that interactive technology will not necessarily result in deep and interactive student learning.

Activity Theory has been a vehicle allowing the researchers to holistically explore the different factors that influence the use of technology as a tool within the literacy teaching Activity System. For instance, the subject brings biases and beliefs to the literacy experience, which influences their views regarding the ability of technology to mediate successful literacy outcomes. In addition, the subject's underlying pedagogical beliefs influence how the tool will be used to mediate the literacy experience. That is, for personal or pragmatic reasons teachers may employ pedagogical practices that vary in their level of interactivity, which consequently impact upon how a technological tool will be used in the literacy session. Aside, this may account for the lack of clarity and variation found in the literature regarding what constitutes effective interactive teaching with technology.

An important factor that was explored in this paper relates to the rules of the literacy Activity System. Essentially the rules afford what can or cannot be done within the Activity System. This is relevant to the inclusion and use of interactive technology for at least two reasons. Firstly, the rules embedded in technology do not always correlate with highly interactive learning practices. For example, in the current study the IWB software would only allow one student at a time to engage with the board. Thus, although the technology was by definition interactive, the interactivity did not support the features of interactive learning. Secondly, the rules that make up the curriculum are influential in determining both how technology will mediate practice, and which types of practices teachers may employ.

For instance, explicit or implicit rules found within the curriculum may motivate teachers to use pedagogical styles, which vary in their degree of interactivity. That is, if the achievement of a specific learning outcome does not require a highly interactive teaching style there is little reason for an educator to use highly interactive tools or methods. A commonplace solution to this problem is to draw closer links between the tool, that is, technology and the specific task to be achieved. However, although changing the curriculum rules this way may guarantee interactive technology is used, it will not guarantee that the technology will be used in a highly interactive manner. That is, it may be more beneficial to change the curriculum rules by drawing closer links between highly interactive pedagogical practices and learning outcomes that use technology as a mediational vehicle.

Lastly, the division of labour between the teacher and students within the classroom often limits or dictates the type of pedagogical and technological interactivity that will be used. For instance, it may more pragmatic for a teacher to employ a less interactive practice when explaining general information to a whole class. However, deep interactive learning that focuses on the co-construction of knowledge, collaborative working practices and discovery problem solving, requires everyone to have a shared role in activity. That is, the traditional division of labour between teacher and students contradicts high end interactive learning (Gibson, 2001). This suggests that it is doubtful that IWB technology can in isolation create an environment that supports highly interactive practices without firstly addressing the rules that divide the labour between the teacher and students.

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