What matters most when students and teachers use interactive whiteboards in mathematics classrooms?







Kimberley McQuillan
Avondale College of Higher Education

Maria Northcote
Avondale College of Higher Education
<maria.northcote@avondale.edu.au>

Peter Beamish
Avondale College of Higher Education

The team from Avondale College of Higher Education answers many questions about the use of interactive whiteboards in the teaching of mathematics. We encourage teachers to consider the implications of IWB use in their classrooms as a result of reading this article.

Background

As teachers, we are encouraged to immerse our students in rich and engaging learning environments (NSW Department of Education and Training, 2003). One teaching tool that can facilitate the creation of rich learning environments is the interactive whiteboard (IWB) (Baker, 2009). IWBs are quickly being introduced into schools across the nation and worldwide, and educators are exploring the implications of having them in the classroom. Of particular interest are student attitudes to the use of IWBs: what students think and feel about IWBs, and what factors matter most to students when IWBs are used in their classroom. Attitudes play an important part in student interest and engagement levels, therefore, it is important to determine current student attitudes towards IWB use in the classroom.

Existing studies have highlighted several possible advantages of IWB use. One such study conducted by researchers in the UK highlighted the positive effect interactive whiteboards have on student engagement and motivation as well as their capacity to facilitate the use of a wide range of learning styles (Schroeder, 2007). In a learning area such as mathematics, where motivation and relevance is sometimes questioned, the use of IWBs may be a relevant tool in reversing this trend. It is claimed that the IWB has the ability to enhance students' learning and retention (Hall & Higgins, 2005; Knight, Pennant & Piggott, 2005). These studies also indicate that using the IWB in the classroom to develop lessons can help educators integrate

ICT more effectively into the mathematics classroom (Hennessy, Deaney, Ruthven & Winterbottom, 2007; Maher, Phelps, Urane & Lee, 2012).

However, some controversy surrounds the use of IWBs since they have sometimes been associated with a revival of delivery-focused, teacher-centred teaching strategies (Kelley, Underwood, Potter, Hunter & Beveridge, 2007). In fact, much of the research conducted so far on their use has focused on teacher use rather than student use (Kennewell & Higgins, 2007). When being used in the mathematics classroom, Swan and Marshall (2010) caution against an overemphasis on two-dimensional as opposed to three dimensional representations in association with IWB use, in light of the hands-on nature of mathematical teaching. However, when used in a way that emphasises student participation, the IWB can be used in mathematics classrooms to incorporate a wide range of strategies for the facilitation of learning. Rather than devaluing the teacher's role in such lessons, the teacher's 'vicarious presence' can be fundamental to the achievement of collaborative and participatory student learning (Warwick, Mercera, Kershnera & Staarman, 2010).

What matters most to students?

When teaching mathematics, the varied representational aspects of IWBs can be used to assist students in achieving specific learning outcomes. IWBs can be used to represent mathematical shapes, activities and processes. In terms of their representative abilities, the benefits and limitations of IWBs have been considered (Bennett & Lockyer, 2008). Even so, despite their many affordances, the use of IWBs, like any other tools, should be used with pedagogical caution and informed intent. Glover, Miller and Averis (2004) suggest that, for the IWB to be an effective teaching tool, the quality of teacher support must be high. If overused or used inappropriately, they have the potential to create misunderstandings and to cause learning difficulties.

This article considers what matters most to the students and teachers who use IWBs, drawing from a study of how IWBs were used in two primary schools. Along with their seven teachers, 130 students from two primary schools participated in this study. They were asked to respond to such statements as "I prefer lessons which are taught with an IWB" and "I dislike going out to the front to use the whiteboard". Their responses were scored on a scale ranging from zero to three. On average students reported a positive attitude to IWBs with a mean of 2.01 (SD = 0.51). Their responses to these questionnaires were supplemented by classroom observations which focused on measuring student engagement and teacher approaches to using IWBs. The classroom observations were recorded according to the level of teacher- or student-centredness observed by the researcher at two minute intervals. A scale of centredness was used to describe the level of student engagement according to three levels:

1. teacher-centred
2. teacher/student-centred
3. student-centred.

In this way, the level of centredness could be observed throughout a classroom lesson in which the interactive whiteboard was being used. The data from the study were analysed collectively to determine what mattered most to students when IWBs were used in their classrooms.

During the study, IWBs were used in most lessons. Important relationships were found between IWB use and student engagement and attitudes by comparing the questionnaire data gathered from the students and teachers, and then comparing this data with the observations recorded by the researcher during lessons when the IWB was used. Teachers were observed using the IWB with confidence and with skill. Students were engaged in these lessons and participated in dialogue surrounding information, resources and activities presented on the IWB.

Attitudes and motivation

The study found that, on average, students' attitudes towards the use of IWBs in the classroom were positive. Students reported that they liked using the IWB. This finding reinforces the outcomes of previous studies which found that the use of IWBs impacted positively on student motivation (Hall & Higgins, 2005; Knight et al., 2005).

Impact on learning

Students and felt that using IWBs positively impacted upon their learning. Many students felt that they learnt more and that it was easier to understand the work when the IWB was used.

Previous use of computers

Students' previous computer experience was found to have little impact on students' attitudes towards IWBs. Most students liked using computers in general and responded positively towards the use of IWBs whether the IWBs were being used by the student, their peers or their teachers. Students noted that computers were "fun" tools which helped them learn.

Engagement

Students reported that their classroom participation was more frequent and that they were more engaged when the teacher employed the IWB. This is not surprising as previous research has shown that when attitudes towards a particular teaching tool, such as the IWB, are positive, then engagement levels are higher (Murcia & McKenzie, 2008). If students like IWBs, then they are more likely to be engaged in their learning as a result.

Variation in engagement

The study showed that engagement levels remain higher when teachers oscillate between teacher-centred and student-centred uses of the IWB. Teachers who use a range of approaches seem to be more successful in gaining and maintaining student engagement.



Figure 1

Gender

Although some previous studies conducted into the use of technology in the classroom have found that male students tend to be more positive about the use of technology than female students (Glover & Miller, 2001; Goldberg, 2001), the study reported in this article found that there was no significant difference between attitudes concerning the use of IWBs in relation to student gender across the 130 student participants.

What matters most to teachers?

The teachers in the study were generally positive about the use of IWBs in their classrooms but also noted a few concerns.

Positive attitude

Like some previous studies (Hennessy et al., 2007; Jones & Vincent, 2006), the teachers in this study expressed positive attitudes towards their use of IWBs. Teachers reported that they liked using the IWB in their classroom and that they felt it enhanced students' learning. They believed using the IWB affected the extent to which students were engaged in the learning process and that the IWB contributed to student learning.

Use of ICT

All seven teachers stated that they liked the fact that IWBs enabled access to a wide variety of technological and internet resources for whole class use.

Tactile nature of IWBs

Teachers reported that being able to touch the IWB and move objects on the screen made students "feel special". The majority of teachers in the study believed that students were more engaged in the learning process when the IWB was used and that the three modalities of learning (visual, auditory and kinaesthetic) were heightened with the use of the IWB.

Interactivity

Teachers acknowledged the potential of the IWB to facilitate interactive learning experiences for their students. Buckley (2002) suggests that a dimension of interactivity, in addition to the student–student and teacher–student interactivity, is the relationship

between digital information and the learning process. All of these forms of interactivity were valued by the teachers in the study.

Student participation

All of the teachers in the study believed that the IWB increased enjoyment and motivation, and that it facilitated student participation. However, only 21% of the students reported that they were permitted to use the IWB in every lesson or in most lessons.

Concerns

In addition to the benefits of using IWBs as teaching tools, the teachers in the study noted a few concerns about their use. Teachers reported that preparation time and connectivity issues provided the most angst when using IWBs in the classroom and that connectivity issues interrupted lessons which, in turn, affected their teaching.

What does this mean for practice?

Findings from this study provide some specific suggestions for how IWBs can be used effectively in primary mathematics classrooms.

Use IWBs

The findings of this study support the use of IWBs in the classroom. When IWBs were used, students felt that they were more involved in their learning and that they were given opportunities to engage in interactive activities. Hence, a major recommendation from the study is that teachers should use IWBs in the classroom to support student learning.

Engagement

Findings from this study showed that while it was evident that average engagement levels were higher when the IWB was used than when the IWB was not used, the type of use was found to influence engagement. Engagement levels of the class were observed during teacher-centred and student-centred use of the IWB. These observations showed that in most instances, the most effective approach is one which alternates between teacher-centred and student-centred learning activities. When the type of IWB use switched from one use to another (for example, teacher-centred to student-centred), engagement levels spiked to a rating of four (out of a possible rating of four). This is an interesting result when contrasted against lessons when IWB use maintained a student-centred approach for an extended period of time, and student engagement levels decreased, just as they did when a sustained period of teacher-centred use of the IWB occurred. In terms of implications for mathematics classrooms, the findings from this study suggest that teachers should use IWBs in a way that combines teacher-centred mathematical activities with that of student-centred mathematical activities.

Software

A substantial amount of IWB software is currently available to schools. Many of the pre-designed lessons and activities that are available using the IWB specific software include mathematics tools and games. From the schools observed in this study, it was noticed that teachers preferred to use familiar computer-based software such as Microsoft PowerPoint, rather than specific IWB software such as Notebook. Instruction on the use of IWB software needs to be employed through professional learning activities for practising teachers and pre-service teachers as this has been shown to increase the use of IWB software in classroom learning activities (Bennett & Lockyer, 2008; Maher et al., 2012).

Student competency

Students liked that IWBs were used for motivational purposes and that they felt competent using the IWBs. Students also felt more involved with their learning when IWBs were being used in the classroom. There was no significant impact from previous computer experience on IWB use in the classroom but further research could



Figure 2

be conducted to investigate the reasons behind students' feelings of competency regarding computers in general. In terms of mathematics lessons, this is important since students with extensive or limited use of computers can be encouraged to use IWBs in relevant mathematical learning activities.

Conclusion

Although this study does not aim to generalise the findings across all school populations, the findings can be applied to the schools involved in the study and may be of interest to educators in similar schools. This study has identified that the pedagogical uses of IWBs do impact on student attitudes towards them. This study has also concluded that teachers' attitudes towards IWBs are generally positive and can be linked to how IWBs are used in the classroom. The way in which teachers use and implement IWBs in the classroom affects the extent to which students are engaged in the lesson.

IWBs can be used to engage students in learning but teachers should mix up student-centred and teacher-centred approaches in short periods of time, thereby facilitating student interaction and high engagement levels in the mathematics classroom.

In summary, this study showed that IWBs can be used as effective tools to engage and involve students in learning. The use of the IWB in the classroom can have an impact on the learning of students. The IWB, when used effectively, has the potential to contribute to the creation of effective learning environments and can greatly assist educators in their efforts to obtain and maintain students' attention, and improve student achievement. This is best achieved by teachers alternating between teacher-centred and student-centred approaches to using the IWB.

References

Baker, R. (2009). Pedagogies and digital content in the Australian school sector. Retrieved 20 April 2010, from http://www.thelearningfederation.edu.au/verve/_resources/Pedagogies_Report.pdf

Bennett, S. & Lockyer, L. (2008). A study of teacher's integration of interactive whiteboards into four Australian primary school classrooms. *Learning, Media and Technology, 33*(4), 289–300.

Buckley, B. C. (2002). Interactive multimedia and model-based learning in biology. *International Journal of Science Education, 22*(3), 895–935.

Glover, D. & Miller, D. (2001). Running with technology: The pedagogic impact of the large-scale introduction of interactive whiteboards in one secondary school. *Journal of Information Technology for Teacher Education, 10*(3), 257–278.

Glover, D., Miller, D. & Averis, D. (2004). *Panacea or prop: The role of the interactive whiteboard in improving teaching effectiveness.* Paper presented at the Tenth International Congress of Mathematics Education.

Goldberg, E. (2001). *The executive brain: Frontal lobes and the civilized mind.* New York: Oxford University Press.

Hall, I. & Higgins, S. (2005). Primary school students' perceptions of interactive whiteboards. *Journal of Computer Assisted Learning, 21*, 102–117.

Hennessy, S., Deaney, R., Ruthven, K. & Winterbottom, M. (2007). Pedagogical strategies for using the interactive whiteboard to foster learner participation in school science. *Learning, Media and Technology, 32*(3), 283–301.

Jones, A. & Vincent, J. (2006). *Introducing interactive whiteboards into school practice: One school's model of teachers mentoring colleagues.* Paper presented at the Australian Association for Research in Education (AARE) Conference, Adelaide.

Kelley, P., Underwood, G., Potter, F., Hunter, J. & Beveridge, S. (2007). Viewpoints: Interactive whiteboards: Phenomenon or fad? *Learning, Media and Technology, 32*(3), 333–347.

Kennewell, S. & Higgins, S. (2007). Introduction: Special edition on interactive whiteboards. *Learning, Media and Technology, 32*(3), 207–212.

Knight, P., Pennant, J., & Piggott, J. (2005). The power of the interactive whiteboard. *Micromath, 21*(2), 11–15.

Maher, D., Phelps, R., Urane, N. & Lee, M. (2012). Primary school teachers' use of digital resources with interactive whiteboards: The Australian context. *Australiasian Journal of Educational Technology, 28*(1), 138–158.

Murcia, K. & McKenzie, S. (2008). *Whiteboard technology: engaging children with literacy and numeracy rich contexts.* Final report to DEEWR. Canberra: Department of Education, Employment and Workplace Relations.

NSW Department of Education and Training. (2003). *Quality teaching in NSW public schools: A discussion paper.* Ryde, NSW: Professional Support and Curriculum Directorate.

Schroeder, R. (2007). Active learning with interactive whiteboards: A literature review and a case study for college freshmen. *Communications in Information Literacy, 1*(2), 64–73.

Swan, P., & Marshall, L. (2010). Revisiting mathematics manipulative materials. *Australian Primary Mathematics Classroom, 15*(2), 11–17.

Warwick, P., Mercera, N., Kershnera, R. & Staarman, J. K. (2010). In the mind and in the technology: The vicarious presence of the teacher in pupil's learning of science in collaborative group activity at the interactive whiteboard. *Computers and Education.*