



Interactive whiteboards in the classroom

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Introduction

Aims of this report

The key aims of this report are to extract some of the key findings relating to the use of interactive whiteboards (IWBs) in UK classrooms from the research literature. From these findings we then extrapolate some of the key issues and debates in order to put forward some initial recommendations relating to more effective use, and also some ideas and suggestions for potential future developments in terms of teaching, training, use and design of IWBs.

The report is not an academic report and therefore does not attempt to comprehensively nor systematically review all of the research literature in the field. Rather it has drawn on the research in order to produce a document that will add to and stimulate debates around the future use and design of IWBs, particularly in relation to current policy, initiatives and future educational practice and pedagogy.

The overall intention is to help us move away from simplistic arguments around whether IWBs are 'good' or 'bad' per se, to ones that are more nuanced and sophisticated, which consider the optimum conditions for effective use; the factors that may support such use; the aspects that may influence future developments; as well as the types of evidence needed that will enable us to implement appropriate changes.

Background to the report

This report was written by Futurelab in partnership with Promethean in order to stimulate debate around the use of IWBs, but was initially written as background reading to support a jointly hosted debate for policy makers, developers, researchers and practitioners, entitled: 'Do IWBs have a future in the UK classroom?', held in London on 24 May 2007.

Whilst both organisations are quite different in their aims and roles, both have a vested interest in exploring the potential, improvement and development of new technologies to enhance and improve learning and teaching.

1. Issues, themes and gaps in existing evidence

Variable findings

Despite selective interpretation of recent research reports by the media, the evidence surrounding the use of IWBs tends to reveal a very mixed picture. For example, on the one hand there are reports that identify how IWBs have been used to significantly improve and extend teaching and learning practices, through aspects such as better display facilities, greater ability to provide better clarification and visual representation, modelling and explanation of 'difficult' concepts, as well as engaging and motivating pupils more effectively, helping increase attention spans and improve focus (See Kennewell and Beauchamp 2007; Smith et al 2005). Wallace (2007), for example, suggests that IWBs and associated software have enabled a greater tactile connection between learners and the learning content, enabled modelling and simulation activities to be presented more readily, with the use of boards also adding to the 'theatrical tension' within the classroom which creates a more captivating learning environment. Their use can also support the immediate collection and analysis of pupil inputs in ways not previously possible (Moss et al 2007).

On the other hand, other research suggests that the mere introduction of such technologies is insufficient to promote greater interactivity in the classroom, and indeed, that use may have had detrimental effects. From this perspective the assertion tends to be that IWBs have been appropriated to reinforce and facilitate more didactic approaches and increase teacher control and 'ownership' of classroom interactions. The majority of research, however, falls somewhere between the two and is far more nuanced, identifying some of the reasons underpinning both effective and less effective usage.

As Moss et al (op cit) point out, whiteboards may represent a significant development, allowing teachers to organise and manage information, their classrooms and content more effectively and efficiently, but that does not automatically translate to better quality of teaching and thus a better learning experience for learners. Higgins et al (2007) further note that it is the skills and professional knowledge of the teacher mediating interactions with pupils that is the crucial factor in determining how much 'value' is gained from IWBs.

The research in this field varies significantly in terms of quality, complexity, length and size of study, the stage, age of pupils and sector, and the usefulness of findings in

terms of moving debates and practice forward. This is not to say by any means that the work in this area is poor, but rather that the different scope makes any meaningful meta-analysis difficult. There is certainly some excellent work in the field and this has been drawn on extensively to inform this report.

There is a tendency in some cases to operationalise 'traditional measures' as proxy for impact of IWBs. Not unlike the broader research literature measuring impact of new technologies, there appears to be an underlying 'political' imperative to seek out the 'killer app' for improving 'test scores'. Numerous researchers and educationalists, however, acknowledge that this may be misplaced, not only because of the tenuous nature of 'casual links' or correlations, but also because there are a plethora of other variables that are both difficult to isolate and account for, and which may also be interrelated.

Further research required

Reviewing the research in this field shows that the evidence on use and impacts remains somewhat unclear and variable. It is clear, however, that our understanding about the utility and potential of IWBs would be greatly improved by further research that is:

- **Longitudinal:** that captures any changes in teacher practice, learning and perceptions of learners over time; the degree to which this practice is continued and built upon; and which also investigates a range of potential 'impacts' and whether the effects on learners and learning are sustained or short-lived.
- **Focused on particular pedagogies and pedagogical practices:** and how these inform and/or mediate the use of IWBs in the classroom. Specifically identifying the circumstances and approaches that give rise to the greatest degree of meta-cognitive engagement; interactivity in the classroom context; and especially in relation to the principles of personalisation.
- **Interventionist:** that starts out with the specific intention of working with practitioners and learners to consider approaches and tactics that develop better learning and teaching strategies. Also approaches which aim to increase interactivity, collaboration and classroom participation, identifying strategies that might enhance and transform pedagogical practice. Such research could also identify the key resistances and barriers, and develop change mechanisms and

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actions that can lead to better use of IWBs and more empowering learning environments.

- **Design-focused:** research and development work that incorporates wider educational visions into the design and development of the next iterations of the technology and the practice associated with it - which better embeds the principles of collaboration and interactivity in the application of the technology to classroom practice.
- **Learner-centred:** research that focuses on the use and impact of IWBs from the perspective of the ultimate 'end user', the pupils. Such research could consider the development of learner-focused and alternative taxonomies of 'impact measures' and classroom practice and approaches.
- **Focused on alternative impact measures:** for various reasons, often relating to political necessity, research into IWBs is focused largely on 'traditional' impact measures that relate directly or indirectly to broader organisational and systemic standards and measures. However, it could be argued that these are not always the best measures for capturing effects on learning and teaching. For example, there may be tensions between using IWBs to increase interactivity in classroom practice and the requirements of externally defined targets. Research that considers alternative impact measures (and constituent elements) and definitions of successful classroom practice and learning might be explored. This is necessary, particularly in relation to the type of educational futures and dynamic learning environments required for learners to develop appropriate skills and competencies required in the 21st century.

2. Key research findings

IWBs changing and improving learning and teaching practices?

Despite sometimes simplistic reporting, the research in the field does identify a broad range of positive impacts of the use of IWBs. These include evidence suggesting gains in children's sense of positive identity (Somekh et al 2006; Somekh and Haldane 2006; Walker 2003); increased enjoyment, engagement and motivation; and positive impacts on behaviour (Adrian 2004); as well as greater collaboration and participation in lessons by pupils (cf Levy 2002; Becta 2003). IWBs also have the potential to help teachers to bring aspects of their outside world into the classroom, and thereby create more authentic contexts for situated learning (Somekh 2006b), and to create more immersive and engaging learning environments.

As a presentational device, and when well used, IWBs have been noted to offer a versatile and dynamic teaching and learning tool, with the added abilities related to relative ease of use, storage and retrieval of work by teachers, which can in turn have a potentially positive impact on teacher workloads (Glover and Miller 2001). The ability to save, store and reuse information, and the multimodal affordances, can enable pupils to focus more clearly on the content being displayed, and can allow teachers greater opportunity to present information in keeping with various preferred learning styles. This in turn can present pupils with more varied opportunities to understand complex concepts (cf Smith H 2001; Bell 2002). However, whilst this may be possible, it depends as much on the ability of individual teachers to differentiate their teaching approach to those styles. Moreover, the ability to dynamically represent abstract concepts is perhaps more relevant and obvious in some subjects than others (see Moss op cit). Nonetheless, the multimedia resources that can be incorporated can facilitate greater variation in terms of content delivery.

The recent report from the Institute of Education (Moss et al *ibid*) focused on a project that substantially increased the spending on IWBs in London secondary schools. The findings from the project suggested that IWBs were relatively easy to use and to integrate into classroom practice, and also that the vast majority of teachers with access to the technology now reported that they were using it in the majority of their lessons. The relative ease of use is supported in some studies, for example Smith (1999), however other research has highlighted lack of

confidence, and technical and practical issues can present significant barriers that mediate successful integration into pedagogic practices.

Somekh et al (op cit) found there was evidence to suggest that IWBs provided "a public forum for such children to demonstrate their abilities in a non-textual medium" that had not previously been available to the same extent. They too found that a number of secondary teachers felt IWBs had had a positive and radical effect on teaching and learning, enabling them to present concepts more easily and with greater clarity, and as a result, this had a positive impact on students' attention. The impact of IWBs was reported to be significant and to improve teaching and the ambience of the classroom. Overall, whiteboards (and visualisers) were felt to have the most significant impact of all the technologies introduced into the classroom over the lifetime of the ICT Test Bed project, facilitating activities that could not easily be replicated, such as interactive simulations, presentation of maps and diagrams, sharing of artefacts such as digital microscopes, and so on.

Moss et al (op cit) similarly found that the majority of both pupils and teachers had positive perceptions toward the use of IWBs and their impact on learning and teaching. In particular the quality of displays was thought to enhance key aspects of teaching, and more generally, there was a feeling that IWBs had "helped to bring teaching up to date".

As well as the research suggesting there may be differences in the quality of use across schools and subject domains, there is also some evidence to suggest that there are differences across sectors, with some arguing that IWBs are more suited to pedagogical approaches and learning and teaching at nursery and primary levels. There is a growing body of evidence suggesting that IWBs have benefits for teaching younger children, and also pupils with learning difficulties, especially those with motor skill difficulties who may find it difficult to use more 'traditional' technologies (Goodison 2002; Bell 2002). Somekh et al (op cit) also found that teachers in primaries believed the boards had a beneficial impact on learning and teaching, especially in relation to motivation and attention of those pupils with special educational needs.

There is also evidence to suggest that IWBs may be more 'accepted', applicable and used more extensively at primary level because they're viewed as a resource more

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readily identifiable with primary strategies and whole-class teaching requirements. The multimodal aspects allow for concepts to be explained and expressed in different formats and styles, and the often 'tactile' nature of use has been argued to be generally beneficial for pupils of this age, helping to increase engagement and attention by engendering 'theatrical tension' in the classroom. The forthcoming report from the research team at Manchester Metropolitan University (which evaluates the expansion phase of the Primary Schools Whiteboard Project across 21 LAs and the educational impact of IWBs on standards in literacy and mathematics) may help shed more light on this area.

Has anything really changed?

Theoretically, IWBs may offer more opportunities for classroom interaction and active learning than other new technologies (Gerard et al 1999; Bell op cit) and can potentially foster greater flexibility and spontaneity of approach (Kennewell 2001), yet there remains a question mark over the extent to which this occurs. Much of the literature in the field suggests such technologies can support, extend and ultimately transform classroom practice. However, there is much debate as to whether this reflects reality in many cases, and there is perhaps not enough longitudinal research to say whether this indeed might be the case. As Moss et al (op cit) suggest, "the introduction of an IWB does not in and of itself transform existing pedagogies". There is evidence, however, from a range of sources suggesting factors such as increasing familiarity, good training, time and space to practice and try new approaches, and the growth in teacher confidence all can play a role in increasing the likelihood of a greater positive impact on teaching and learning. Certainly, Moss et al (ibid) note that the teachers in their study who were making the most innovative use either had access to the technology for longer or were more committed to exploring its capabilities in time they had to experiment and practice.

It is clearly key that time and opportunity to practice and 'space' to experiment with IWBs can lead to pedagogical changes. The degree to which these changes are transformational, however, is still in question.

Somekh et al (op cit), in their ICT Test Bed evaluation (which focused on 'saturating' a number of institutions with ICT provision), noted that much of the use of IWBs

(and visualisers/slates) in the focus institutions was for whole-class presentations by the teachers. Yet over the three-year research period, the number of primary students who stated they had the opportunity to use the boards to present their own work increased from 50% to 80%. However, despite the many positive benefits identified, the research also suggests that such technologies become easily embedded and used within existing practices, rather than being fundamentally transformative, at least in the short term, and that longer-term transformation requires teachers willing to consistently experiment and innovate with such technologies. Similarly, Smith et al (2006) observed teachers in literacy and numeracy lessons and concluded that IWBs had had an effect on both practice and classroom discourse but that this was not as extensive as some may claim.

Burden (2002) drew on Gibson's work to illustrate three different stages of IWB use that might be identified. These are:

1. **Infusion:** which is largely related to the spread of use of the technology, where the technology tends to reinforce existing practice, and where it is used largely as a didactic tool with learners being largely passive.
2. **Integration:** whereby the technology becomes embedded within the school and the curriculum, with greater emphasis being applied to the ways in which the technology can be applied to support a particular subject or learning goals. There is also more evidence and thought around more active participation of learners' use of IWBs.
3. **Transformation:** which is where the technology is used to 'add value' to the whole learning process. Teachers use and create a range of other resources that enhance the learning process through a more enquiry-based approach, with learners becoming centrally involved in its use and where they actively construct knowledge through interaction.

One central question, therefore, is whether this 'model' denotes some sort of linear progression and whether or not all schools and teachers will reach the transformation stage over time. Other evidence suggests, however, that this is unlikely to be the case and that some struggle to pass the mere adoption or infusion stage, tending to use IWBs largely only as a didactic and/or teacher-controlled tool. This may have as much to do with particular

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pedagogical approaches and also the ethos of some schools and/or teachers that do not always promote more interaction in the classroom and collaborative and participatory approaches to learning.

A set of challenges therefore are:

- How can hardware and software developers, training providers and educators better exemplify practices that may be more transformative?
- Are there clear examples of the various stages and pedagogical insights into how to move beyond mere infusion?
- Is there enough compelling evidence of improved learning that can be used to inspire those teachers who may feel that this requires a change of approach and a significant investment of their time and effort?
- Is there a compelling argument to demonstrate that the use of an IWB allows them to deliver that which they cannot achieve by other means?
- How might hardware and software developers, educators and trainers sketch out the broader political and educational rationale(s) to support teachers to move in this direction? For example, how could and does the concept of personalisation impact on practice when using IWBs?

Those who currently practice within a more teacher-controlled and largely didactic learning environment may be more resistant to using the IWB in a more collaborative way and exploring the interactive affordances. Indeed, even those who are more sympathetic towards collaborative and interactive classrooms may still find challenges in applying the technology to enhance their existing practice.

As with most new technologies, the research suggests many teachers will face a 'cost-benefit conundrum'. This conundrum includes a range of factors such as:

- learning how to use the technology
- time to learn and apply the technology effectively and appropriately
- technical and reliability issues it may, or is perceived to, present
- the availability of appropriate resources suited to their teaching style and subject area(s) and sourcing of these

- finding time and space to practice and take new 'risks' whilst developing their skills further
- set-up times
- the uncertainty that greater collaboration may bring to existing teacher practice in achieving learning objectives within an allotted time
- both the real and perceived implications transformative use might have on classroom organisation, management and control.

From the perspective of Armstrong et al (2005), how can teachers become the critical agents in mediating the technology to provide a more dynamic, interactive and appropriate learning classroom experience?

Some of the more critical research in the field implies that often IWBs do not necessarily encourage interactivity in the classroom any more than the traditional display boards. However, it could be argued that this is perhaps as much a result of the way classrooms are managed and controlled, and the emphasis that is placed on curriculum delivery rather than more collaborative and discursive approaches to learning. In this sense, it is not necessarily the technology that is to blame for the limited interactivity displayed when using IWBs but rather the pedagogical approach and educational structures and practices that characterise the system and which can mediate the potential of new technologies. It has also been argued that technology expansion schemes have not been accompanied by substantial wider debates regarding the underpinning pedagogical approaches and clear exemplification of how the technologies fit with broader philosophical and educational principles. However, it could be argued that we are now faced with a great opportunity to translate current educational policy initiatives into better-informed notions of classroom practice on the back of recent government initiatives and concepts.

3. Interactivity: current limitations and the future of learning?

Perhaps one of the most interesting areas of debate relates to the fundamental issue of classroom interactivity. There is sometimes the misguided assumption that because theoretically a technology has the functionality embedded within it to promote greater interactivity and collaboration, that this will automatically translate into more interactive classroom practice. The reality is, of course, that the design, the positioning, the school ethos, teacher experience and understanding, and so forth, can all mediate the extent to which it is used as a truly interactive pedagogical tool. The exact changes in classroom practice most likely to arise are mediated by the particular uses teachers perceive the technology to have and the degree to which it resonates with their particular 'working pedagogy'.

Moss et al (op cit) identify three key themes that dominate thinking about the potential role of IWBs in changing pedagogy; namely pace, multimodality and interactivity. However, they further suggest that these operate at both surface or deep levels about what contribution they have upon pedagogy. For example, understandings around increased interactivity at a surface level relate more to "the technical and physical attributes of the technology", whereas a deep approach "...embeds the use of the technology more specifically in a broader pedagogic aim". Further, Hennessy et al (2007) suggest that 'deep' interactivity also incorporates approaches emphasising shared cognition, the reworking of pupils' own ideas, and also accounts for aspects of pupils' social and emotional needs. This distinction is crucial to our understanding of interactive learning and teaching, and failure to contemplate these differences adequately will and does lead to confused discussions as to whether IWBs increase interactivity in the classroom.

The question is to what extent interactivity lies within the technology itself, and to what degree is interactivity a product of a designed learning experience, disregarding for the moment the use of technology. The research suggests that when there is a willingness on the behalf of teacher to create an interactive environment at the classroom level, and when this interacts with experience and understanding of the affordances of the technology's interactive components, that we are likely to see better and more dynamic interactions with IWBs. Such interactions and experiences are more likely to have greater 'fit' for purpose and are developed with the specific intention of placing learners more centrally in the learning experience.

Higgins et al and Hall and Higgins (2005) further note that the degree to which pupils are able to participate in interactive learning and teaching practices is limited by the emphasis on rigid curricula and 'teaching to test' under a standards agenda that engenders a perceived 'need' amongst many teachers to stringently control the classroom. This can result in pupils' views often being overlooked as the need to deliver curriculum content prevails and the likelihood of many teachers to encourage greater active pupil participation diminishes.

Somekh and Underwood et al (2006) have also questioned the degree to which IWBs might be said to encourage greater interactivity. Whilst there appear to be a number of short-term benefits of using IWBs, they are often used to enhance didactic teaching, as they become embedded through initial adoption and 'fit' within existing pedagogies and practices. Whilst it is noted that new social practices do start to emerge over time, as both learners and teachers begin to experiment with the technology, these still remain largely in line with the general existing 'pedagogic orientation' of teachers.

The actual practical, day-to-day pedagogic orientation of teachers, however, is clearly mediated by the systemic school structures and requirements of curriculum delivery (see, for instance, Hennessy et al 2007), testing and assessment, which can limit, actually or perceptually, the degree of freedom teachers have to experiment with new approaches and technologies. It has been suggested that when teachers have greater classroom autonomy, then there is an increased likelihood of innovative practice occurring (EC 2003). In short, it may be argued that the culture and focus on current national educational priorities, and the accountability that accompanies them, could reduce the likelihood of greater interactivity schools and in the classroom.

For greater innovation to occur that is more likely to lead to transformational practice, teachers need greater time, 'space' (actual and pedagogically experimental) and freedom to experiment with more dynamic and interactive approaches. This may increase the likelihood of the interactive functionality embedded within technology to be utilised to much greater effect.

A number of questions therefore present themselves, including:

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- What are the policies and educational approaches that will provide teachers with the necessary evidence and 'space' to take the necessary 'risks' in order to facilitate greater pupil activity and participation?
- What other 'peripherals' can be used to help teachers move away from the centre of the class?
- What can and should government, local authorities, trainers, school leaders and teachers do to help enable greater 'freedom' to innovate?
- What strategies might teachers, educators and developers put in place to allow learners greater input and ownership over the technology and its application to enable them to be more active participants in a process of collaborative lesson content creation and development? And how can we best give them constructive feedback on their input?

The concept of interactivity is a difficult one to define and is often approached unproblematically (Hall and Higgins 2005), with different interpretations being operationalised when employing the term. For example, interactivity as a concept can be considered at individual, small group, whole class and school levels.

If a key aim is to promote more dialogue, discussion, learner control and participation, then what steps can be taken to promote interactivity at each of these levels? It is only in considering the concept of interactivity in a more holistic way that we are more likely to begin to develop the cultures and 'space' to enable teachers the freedom to innovate.

Kennewell et al (2005) conceptualise interactivity in whole class teaching on a continuum depending on:

- the degree of teacher/pupil control
- the nature of the interaction
- the nature of the scaffolding provided through dialogue.

The greater the degree of interactivity, the more likely we are to witness practices such as collective reflection, reflective scaffolding - characterised by two-way dialogue and active participation - greater opportunities for pupils to influence the direction and content of lessons, and more collaborative co-construction of knowledge. However, much of the research implies that in the current cultural context of education, IWBs are often used to place the

teacher at the centre of the teaching process, directing the transmission of knowledge, rather than as facilitators of co-constructed knowledge as described above. From this perspective, the introduction of a technology with numerous embedded interactive affordances does not necessarily lead to a more interactive pedagogy (Kennewell et al 2000). Ultimately, access to and control of the technology is mediated by the teacher, whose practice is in turn mediated by the structuring principles and real and perceived requirements of the system. Interactivity is not necessarily so much about the affordances of the technology, but there is much research to suggest that the best and 'deepest' learning occurs when learners are active, have more control of the content development and interactions in lessons, and where there is greater dialogue around learning episodes.

Future opportunities?

Constructing learning environments and technology use as 'learner-owned' or learner-orientated practice can be a significant challenge for many teachers in today's climate. Ultimately, at the heart of the above debate is a much broader underlying question surrounding approaches to learning and teaching, which highlights the tensions in the current educational and political context. Yet it is around this tension that there are perhaps the greatest opportunities for action to increase interactivity and pupil involvement in classrooms. The government's e-strategy clearly outlines the need to "transform teaching, learning and help to improve outcomes for children and young people through shared ideas, more exciting lessons...". Likewise the current personalisation agenda aims to give greater voice to learner demand, empower learners and increase choice and opportunity to reconfigure the system. This includes reconsidering curriculum, pedagogy and assessment practices around learner needs. This then suggests that greater interactivity in classrooms could be an effective way of creating the necessary culture of dialogue and participation underpinning personalisation. A clearer message therefore needs to be sent to the teaching profession and training providers by the government and its agencies about the desired system level changes, with clearer links being made between these and the types of changes in practice that might be required to deliver this vision. Similarly, the government must react to alleviate, wherever possible, the real and perceptual barriers that teachers feel mediate such practice.

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We therefore suggest that:

There is a clear need for the government and training providers to exemplify deeply interactive learning experiences and environments at classroom level. These should include examples and suggestions about the ways in which various technologies, including IWBs, might be used to enhance such experience. Clear reference to the policies, strategies and initiatives that underpin this needs to be made, and a clear statement to help teachers and schools recognise they have 'permission to innovate' in this area. This should not, however, take the form of a 'how to' approach, as this might be viewed as top-down and prescriptive, but rather it should seek to encourage teachers to be active in developing their own specific approaches, informed, but not prescribed by, a clear and transformational educational vision of the future.

The future of design of IWBs?

We must consider the historical and educational contexts in which IWBs were initially designed and developed. The notion of an approximate 1:30 classroom with the teacher at front 'controlling' the lesson through a process of 'knowledge transfer' was clearly (and many argue still is) a 'given', determined by historical and political guidelines, requirements and foci. Utilising the interactivity embedded within the technology therefore presents a cultural challenge to teachers and schools who may be reticent in relinquishing ownership and control of the classroom to facilitate more interactive approaches.

It would therefore have been difficult, challenging, and perhaps reckless from a business perspective, to design anything initially for the market that would fundamentally challenge this status quo. However, whilst IWBs largely remain at the front of classrooms, increasingly we have seen the development of software that can and does increase the opportunity for more dynamic classroom practices, and there is much evidence to suggest this is happening in more classrooms, at least at certain times and for particular purposes.

In short, the context and the 'educational technology marketplace' at that time did not present many viable options for designing anything other than a tool which

would fit in with the prevailing educational context. We are now seeing, however, the development of software and practices that are beginning to create new potential learning possibilities that promote greater collaboration and interactivity, and accompanying hardware developments and redesign are already beginning to emerge. We have also witnessed policies and initiatives that are using language suggesting a need to place learners at the centre of the learning process, giving them more voice and making the system more responsive to their needs, thereby going some way to personalising education. If and when these two developments harmonise, then perhaps we will see the emergence of a new wave of interactive technologies that are designed for a specific, wider learning purpose. However, if this does occur, we should avoid past mistakes and ensure that there are clear and understood pedagogical applications (and implications) that resonate with the broader educational vision. This will allow schools to make more informed choices around purchasing and enable teachers to make better choices about whether they want, and if they are ready, to use any such new developments to transform classroom practice. Clearer guidance and training support could also be developed that thoroughly accounts for pedagogical transformation to ensure better use and greater classroom interactivity result.

How can designers and developers of this 'next wave' of interactive technologies create the sort of tools that result in products and services geared towards learner demand?

What are the technological developments that are likely to account for system and practice changes over the next decade?

Technological developments mean there are now more opportunities to develop personal or small group shared devices and applications. There is software, some freely available, that allows what is displayed on the large screen to be delivered to personal or shared devices. Ongoing developments are being undertaken that will increase the likelihood of this being a more regular two-way process from personal devices to display screens (including two-way multiple user input), which increasingly will open up the possibility of screens being used for both 'receiving' and 'transmitting' and constructing knowledge, potentially placing learners more in the role of co-constructors of classroom content.

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From a hardware design perspective the following represent areas for research and development:

- Possibilities such as curved or seamless boards, or individual 'intelligent' boards that can interlock depending on the required size for the task and number of students working on it. Developments in this area could place learners in greater control and allow easier movement between whole-class activities, smaller group or individual working, multimodal presentations and manipulable tasks.
- Table-top interactive boards and displays that allow collaborative activities. Individual or smaller shared interactive slates, screens or tables rather than a single board.
- Personal or small group board with adjustable height and portability to increase sustainability and use.

From a software design perspective:

- More tools to enable transfer of data and knowledge from individual technologies to central boards for discussion and reflection activities.
- Increased use of video-conferencing facilities in smaller group or individual technologies to allow collaborative working across sites.
- Pedagogical prompts for teachers built into the software promoting greater interactive activities, learning support and scaffolding for pupils to enable greater reflection and deeper learning.

There are also a range of supporting materials and approaches that could be developed to help foster a culture of innovation in the use of IWBs:

- Links to the policies and initiatives that promote or encourage transformational learning with suggestions of how to execute this in order to justify experimentation.
- Examples of where time and space for experimentation with new teaching styles and tools have been undertaken and how.
- Guidance that emphasises how such tools can be used in creating immersive and engaging experiences and learning environments rather than for content delivery.
- Development of networks of innovative educators who understand the pedagogical underpinnings of classroom practice to support knowledge exchange.

- Where possible provide external research expertise to advise on the aspects of transformative practices and new pedagogical practice.
- Increased opportunities to make materials and resources used with IWBs available to teachers and pupils in other locations for reflection and extension.

It may be argued that with a clear understanding of the benefits of collaboration and participation, greater interactivity in the classroom could be stimulated without the use of technology. Nonetheless, IWBs and other new technologies can significantly enhance and facilitate this process if there is a clear understanding of how this can occur and the pedagogical approaches underpinning them. There is a need for the understanding of pedagogical approaches and the utility of the technology to become more closely connected, and for teachers and schools to realise the full potential to create more dynamic and interactive lessons that promote an active learning disposition amongst learners.

4. Conclusion

As this report points out, the utility and interactive functionality of IWBs can be limited by a range of factors. We should therefore view with healthy scepticism claims of direct and or causal links with impacts on attainment. This is not to say that the research evidence in the field does not provide us with a wealth of information on which to build, and in some cases, to make more robust claims about the benefits to learning and teaching that IWBs may support. Indeed, there are many positive findings reported and perhaps as, if not more, importantly, there are those which identify gaps, and provide insight into areas for improvement and development. Whilst many benefits of using IWBs are reported, this is far from universal, with a number of reported difficulties and challenges. This is not to say that the fundamental aspects of existing IWB technology are not potentially excellent tools to support learning and teaching, only that there are other factors to carefully consider. IWBs were developed with the intention to help enliven the delivery of educational content within the then existing framework, and we should not expect IWBs to be a panacea for challenges to more collaborative and interactive learning at a system level.

It is perhaps, therefore, the debates around the broader notion of interactivity that offer the greatest potential for development, particularly if reconciled with the principles embedded within newer and emerging policy drives. In considering these broader visions, we may be better placed to ensure an approach based around wider pedagogical transformation and the development of a personalised educational future that can support learners in developing the kinds of key skills and competencies required for the 21st century. This requires giving greater consideration to learners' needs, placing them at the centre of, and more active in, learning processes and enabling them to have a direct impact on and choices over lesson and curricula content. In turn, this demands a shift in pedagogical practice for many teachers and schools. Focusing on how IWBs might be used more effectively to deliver this sort of educational vision should help educators, trainers, developers and policy makers focus more acutely on the transformational pedagogies, which in turn should affect their own practice. New and exciting developments in both hardware and software in coming years are likely to change our perceptions of IWBs and how and for what they can be used, making them a much more diverse and flexible tool suited to a range of pedagogical practices.

Moss et al (op cit) suggest that the teaching profession should engage in broader discussions as to the ways in which IWBs can be used to extend and transform existing practice. In doing so there is a greater likelihood that the pedagogic purpose will be foregrounded. They also suggest that trainers should focus on the broader pedagogic aspects of classroom interactivity and that teachers should consider more carefully when it is more appropriate to use the technology and for what purposes.

5. References

- Armstrong, V, Barnes, S, Sutherland, R, Curran, S, Mills, S and Thompson, I** (2005). Collaborative research methodology for investigating teaching and learning: the use of interactive whiteboard technology. *Educational Review*, Vol 57, No 4, November 2005
- Becta** (2003). What the Research Says About Interactive Whiteboards. Coventry: Becta.
www.becta.org.uk/page_documents/research/wtrs_whiteboards.pdf
- Bell, MA** (2002). Why use an interactive whiteboard? A baker's dozen reasons! *Teachers.Net Gazette*, 3 (1), January 2002
- Burden, K** (2002). Learning from the bottom up – the contribution of school based practice and research in the effective use of interactive whiteboards for the FE/HE sector. Discussion paper presented at LSDA, Making an Impact Regionally Conference. The Earth Centre, Doncaster, 21 June 2002. www.lsda.org.uk/files/lsda/regions/8_Bio_KBurden.pdf
- Gerard, F et al** (1999). Using SMART board in foreign language classrooms. Paper presented at SITE 99: Society for Information Technology and Teacher Education International Conference, San Antonio, Texas, 28 February–4 March 1999.
- Goodison, TAM** (2002). Learning with ICT at primary level: pupils' perceptions. *Journal of Computer Assisted Learning* 18, pp282-295
- Glover, D and 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), pp257-276
- Hall, S and Higgins, S** (2005). Primary school students' perceptions of interactive whiteboards. *Journal of Computer Assisted Learning* 21, pp102-117
- Hennessy, S, Deaney, R, Ruthven, K and Winterbottom, M** (2007). Pedagogical strategies for using the interactive whiteboard to foster learner participation in school science. *Learning, Media and Technology*, Vol 32 No 3 pp283-301
- Higgins, S, Falzon, C, Hall, I, Moseley, D, Smith, F, Smith, H and Wall, K** (2005). Embedding ICT in The Literacy and Numeracy Strategies: Final Report. Centre for Learning and Teaching, School of Education, Communication and Language Sciences. Newcastle: University of Newcastle upon Tyne
- Higgins, S, Beauchamp, G and Miller, D** (2007). Reviewing the literature on interactive whiteboards. *Learning, Media and Technology*, Vol 32 No 3 pp 213-35
- Kennewell, S** (2001). Interactive whiteboards – yet another solution looking for a problem to solve? *Information Technology in Teacher Education*, 39, Autumn 2001, pp3-6
- Kennewell, S, Parkinson, J and Tanner, H** (2000) *Developing the ICT Capable School*. London: Routledge/Falmer
- Kennewell, S, Tanner, HF, Jones, S, Parkinson, J, Norman, MA and Meiring, L** (2005). Characterising interactivity in the teaching of different subjects using ICT in secondary schools. Paper presented in symposium on Interactive Teaching and Interactive Technologies, BERA 2005, University of Glamorgan, Pontypridd, 15-17 September
- Kennewell, S and Beauchamp, G** (2007). Features of interactive whiteboards. *Learning, Media and Technology*, Vol 32 No 3 pp227-241
- Levy, P** (2002). Interactive Whiteboards in Learning and Teaching in two Sheffield Schools: A Developmental Study. Sheffield: Department of Information Studies, University of Sheffield
- Moss, G, Jewitt, C, Levañiç, R, Armstrong, V, Cardini, A, Castle, F** (2007). The Interactive Whiteboards, Pedagogy and Pupil Performance Evaluation: An Evaluation of the Schools Whiteboard Expansion (SWE) Project: London Challenge. Institute of Education, University of London/ DfES: London
- Somekh, B, Underwood, J et al** (2006). Evaluation of the ICT Test Bed Project Annual Report March 2006. Becta: Coventry. www.evaluation.icctestbed.org.uk/files/ict_test_bed_evaluation_2005.pdf
- Somekh, B and Haldane, M** (2006). How can interactive whiteboards contribute to pedagogic change? Learning from case studies in English primary schools. Paper presented at: Imagining the Future for ICT and Education Conference, 26-30 June 2006, Ålesund, Norway.
ifip35.inf.elte.hu/alesund/?q=node/155
- Smith, A** (1999). *Interactive Whiteboard Evaluation*. MirandaNet
- Smith, H** (2001). *SmartBoard Evaluation: Final Report*. Kent: NGfL

5. References

Smith, HJ, Higgins, S, Wall, K, Miller, J (2005). Interactive whiteboards: boon or bandwagon? A critical review of the literature. *Journal of Computer Assisted Learning*, 21, pp91-101

Smith, F, Hardman, F and Higgins, S (2006). The impact of interactive whiteboards on teacher-pupil interaction in the national literacy and numeracy strategies. *British Educational Research Journal* 32(3): 443-457

Walker, D (2003). Quality at the Dockside. *TES Online*, 3 January 2003, pp66-67

Wallace, A (2007). Presentation at: Do IWBs have a future in the UK classroom? Promethean/Futurelab debate, London, 24 May 2007

Other related resources

It is worth noting that there is another DfES commissioned report on IWBs forthcoming:

Somekh et al (forthcoming). Evaluation of Schools Whiteboard Expansion (SWE)

ICT, Pedagogy & Learning Research Group: Manchester Metropolitan University/DfES/Becta

The collection of papers below provides a thorough and informative look at the research into IWBs:

Learning, Media and Technology, Vol 32 No 3, 2007. Special Issue. The Interactive Whiteboard Phenomenon



This publication is available to download from the Futurelab website – www.futurelab.org.uk/events/listing/whiteboards/report.

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